THE AMERICAN JOURNAL OF ROENTGENOLOGY
RADIUM THERAPY AND NUCLEAR MEDICINE

VOL. 76 DECEMBER, 1956 No. 6

BENEFITS TO MANKIND THROUGH INTEGRATION OF PHYSIOLOGY AND RADIOLOGY*

By W. EDWARD CHAMBERLAIN, M.D.
PHILADELPHIA, PENNSYLVANIA

MY FATHER, who, by the way, was a member of this Society from 1904 to 1914, purchased his first roentgen-ray equipment in 1898. My earliest memory of a contact with roentgen rays was in 1900 when I was eight years old. Dad put on an "x-ray" party for friends, relatives and neighbors. We all gathered in the big "reception room" of his offices. The roentgen tube and its Wimhurst static machine exciter were in the next room and my father gave the party an extra punch by utilizing the rays after they had penetrated the lath and plaster partition into the reception room. There we were safe from high voltage sparks if not from whole-body radiation, and great was the excitement as we viewed each other's skeletons, moving jaws and joints, respiratory movements and pulsating hearts.

I am reasonably sure that the ray-proofing of that party's environment was inadequate, to say the least. But the old gas tube had to be rested now and then, and there was safety in numbers. Each member of the party had to limit his time behind the fluoroscopic screen because the next-in-line was impatiently waiting.

In the early days of glass plates, limited voltages and small tube currents, exposure times for roentgenography were very long. This often resulted in the blurring of important details through motion, so fluoroscopy must have stimulated a continuing interest in the study of function. Thus, the integration of physiology and radiology had early beginnings. But progress was slow until the relatively recent development of adequate cinefluorographic techniques.

In San Francisco back in 1916 and early 1917, a residency in radiology was unheard-of, but I served a sort of apprenticeship in the radiologic establishment of my old chief, Howard Ruggles. Dr. Ruggles was one of the first to appreciate the importance of cineroentgenographic techniques in the study of function and he and I spent a good many hours trying to figure out a possible way to get a sequence of roentgenographic plates at the rate of 16 per second, from which a motion picture might be made.

Our choice of the direct method (adequately rapid sequence of full scale roentgenograms, later to be photographed onto

* President's Address delivered before the Fifty-seventh Annual Meeting of the American Roentgen Ray Society, Los Angeles, California, September 25–28, 1956.

cinefilm) in preference to the indirect method (cinefilm photography of the image on a fluoroscopic screen) was based upon direct measurements, which we made ourselves. Using an ordinary "still" camera and such fluorescent screens as were then available, we soon demonstrated that the indirect method would require large lens apertures, high tube currents and fast photographic film speeds that were unheard-of in 1917.

Our 1916–1917 experiments accomplished little beyond convincing us that the direct method was the one with a real chance of success. Then World War I was upon us and we were soon both in uniform, the "Chief" in the army and I in the navy.

During the war, production of roentgenographic film began. At once Ruggles saw the possibility of accomplishing his purpose by passing a long strip of roentgenographic film through an intermittent-advance mechanism that would be a sort of enlarged version of an ordinary photographic movie camera.

Work went on sporadically from the time we returned to civilian life in 1919. When I left the team in 1920, there still appeared to be some "insurmountable obstacles," but in 1925, with the help of a well-trained (United States Navy Submarine Service) mechanic, Mr. E. P. Fletcher, a remarkably successful result was obtained. On a projection of that first x-ray movie, made in 1925 with the "roentgen cinematograph of Ruggles," it can be observed that the measured sequence rate of fifteen frames per second (instead of the planned sixteen per second) was adequate, and the projected film exhibits a quality of lung and bone (rib) detail which is still lacking in most of our present-day "x-ray movies."

Having produced this one excellent "x-ray movie," Dr. Ruggles turned his attention to other problems and apparently lost interest in his "roentgen cinematograph." One day he said, "Ed, I'm not going to use it any more. You're interested in physiology. Take it over to your place and see what you can do with it." That is how the Ruggles device came to Stanford, where William Dock and I, with the help of Robert Newell, developed "skiacardiography,"[1,2] reviewed roentgen kymography and laid the groundwork for what developed later, at Temple University Medical School, into "roentgen electrokymography."[3,4,5]

It is fun to look back at our early experiences. At this point I would like to describe for you a typical bout with Dr. Ruggles' marvelous but temperamental device. I will first describe the action as it occurred on a successful run. Each complete cycle occupied 1/15 second (fifteen exposures per second). Each such cycle consisted of two phases, a phase during which the film was being advanced, and a phase during which the "duplitized" (double-coated) roentgenographic film was tightly squeezed between intensifying screens during the roentgen exposure. The film was supplied to us in strips 8 inches wide and 30 feet long. During the "film-advance" phase of each cycle it was drawn through the exposure frame by rubber-covered rollers for a distance of eleven inches, while a mechanism of eccentrics and connecting rods held the two intensifying screens apart and released a pair of brake shoes designed to prevent movement of the film during the making of each exposure. When the film had advanced eleven inches, the rubber-covered rollers no longer gripped it firmly between them, for they were broadly notched, and the brakes were at that instant applied to the edges of the film. The intensifying screens were then forced together and the new area of film was in place and ready for exposure. The above train of events occupied a total time of 1/24 second. During this interval the high tension line between the roentgen ray machine and the roentgen tube was disconnected by a high-tension, oil-immersed switch in the anode conductor. This switch was operated by a shaft from the rollers which moved the film. At the instant that the intensifying screens

made contact, the high-tension switch closed and remained so for 1/40 second. The switch then opened again, the intensifying screens separated, the brakes were released, and the rotating rubber-covered rollers again gripped the film to draw it forward another eleven inches.

In action this machine could be quite terrifying. In the first place, it sounded like an extra-high-speed machine gun, each explosion-like bang being caused by the sudden rapid shortening of the ample film loop adjacent to the picture frame. This fiendish noise (fifteen cycles per second is 900 per minute, 50 per cent faster than an ordinary 600-per-minute machine gun) had to be endured in a darkened room—that is, a room as dark as we could make it, with a great deal of flickering "corona" from the high tension wires to give us a weird kind of completely ineffective illumination. And then there was always the suspense, because so often the demon made a sort of celluloid spaghetti out of the film we had so carefully wound on its feed roll. In all, it sometimes seemed to me that it was risky business to submit our seriously ill cardiac patients to such an ordeal, and on one occasion I became convinced that the patient would "never be the same again." However, in spite of its bad habits and unstable temper, the roentgen cinematograph of Ruggles made history and showed the way.

There have been many contributors to the technology of "x-ray movies," but I want to pay special tribute to Ramsey and his associates at Rochester, New York. This group carried cinefluorography (the indirect method) to the ultimate limit of its possible development in the absence of the electronic aids which are just now taking over the field.

These electronic aids are of two main types: (1) those utilizing the principles of television, and (2) those utilizing the principles of the "image tube" (electron microscope, "sniperscope," "snooperscope"). Both types have been effectively exploited for the benefit of physiology as revealed by the roentgen ray. At the recent Eighth International Congress of Radiology, Mexico City, July, 1956, Bouers of Einthoven contributed a remarkably complete exposition of the many possible combinations of fluorescent screens, electron-emitting surfaces, optical systems and electron optics that are now available or will shortly be available for this purpose.

With the help of these new electronic devices for image intensification, roentgen cinematography has suddenly become an important tool for the physiologist. Short bursts of film may be made at sequence rates of 30, 60, 100, even 200 frames per second, then projected at 12 to 24 frames per second for "slow motion" analysis. And these cine techniques have other advantages (over fluoroscopy, for example). Once a strip of cinefilm has been exposed and processed, it is available for prolonged and repeated study *without further exposure to the patient*, while in the case of fluoroscopy the patient must be subjected to additional roentgen ray exposure in connection with each and every such prolongation or repetition of our observations.

The physiologist is not the only one to benefit from these new techniques. The practicing physician will certainly be able to make earlier diagnoses with their help, for it is well-known that disturbances of function often precede disturbances of morphology.

Discussions regarding these cine techniques for the radiologist and physiologist often evoke the remark that the costs are prohibitively high. I would remind you that in 1896, shortly after Röntgen's announcement, the newspapers carried items that went something like this: "Of course, these x-rays are scientific curiosities. The doctors will not be able to afford them. Why, the equipment for making x-ray pictures costs all of $300." How soon the luxury of yesterday becomes the necessity of today. Now-a-days we may spend as much as $30,000 for "the equipment for making roentgenograms." As the integration of Physiology and Radiology con-

tinues, we may be sure that the cost of the equipment for cineroentgenography, whatever it may be, will not stand in the way.

3401 North Broad Street
Philadelphia 40, Pennsylvania

REFERENCES

1. CHAMBERLAIN, W. E., and Dock, W. Study of heart action with roentgen cinematograph. *Radiology*, 1926, *7*, 185–189.
2. CHAMBERLAIN, W. E., and DOCK, W. Motion of heart in disease of mitral valve; cinematographic roentgen-ray studies. *Arch. Int. Med.*, 1927, *40*, 521–531.
3. HENNY, G. C., BOONE, B. R., and CHAMBERLAIN, W. E. Electrokymograph for recording heart motion, improved type. AM. J. ROENTGENOL. & RAD. THERAPY, 1947, *57*, 409–416.
4. BOONE, B. R., CHAMBERLAIN, W. E., GILLICK, F. G., HENNY, G. C., and OPPENHEIMER, M. J. Interpreting electrokymogram of heart and great vessel motion. *Am. Heart J.*, 1947, *34*, 560–568.
5. CHAMBERLAIN, W. E. Roentgen electrokymography. *Acta radiol.*, 1947, *28*, 847–858.

VOL. 76, NO. 6

OSTEOID OSTEOMA*

By ROBERT A. FLAHERTY, M.D.
Fellow in Radiology, Mayo Foundation†

DAVID G. PUGH, M.D.
Section of Roentgenology
and
MALCOLM B. DOCKERTY, M.D.
Section of Surgical Pathology, Mayo Clinic and Mayo Foundation
ROCHESTER, MINNESOTA

JAFFE,[13] in 1935, was the first to recognize osteoid osteoma as a definite clinical and pathologic entity. He expressed the belief that the lesion is a benign bone tumor originating from osteoblastic mesenchyme and having a peculiar tendency to form large amounts of osteoid. He has maintained this conviction, as expressed in subsequent papers. Although most investigators, including us, now agree with this opinion, some well-qualified observers believe that the lesion is inflammatory in origin. This controversy has been considered at length elsewhere and will not be repeated here.

Osteoid osteoma is not a rare tumor. Since Jaffe[13] first described it, numerous reports on its clinical, pathologic and roentgenologic features have been presented, so that now it is a well-known entity. Pathologically the tumor is distinctive. The clinical findings are usually characteristic but can be bizarre. The roentgenologic manifestations are often typical, but sometimes they are such as to make a definitive diagnosis difficult.

PRIOR REPORTS

Prior to 1935, there were reports on the unique pathologic characteristics of osteoid osteoma but these reports did not describe the lesion as an entity.[1,23] Also, typical osteoid osteomas had been described as other conditions.[5,28] In 1935, Zanoli[39] reported a case that was similar to the one reported by Jaffe, but he interpreted the condition as a phase of aseptic necrosis. In 1936, Jaffe[14] reported six cases and Marziani[22] reported one. In 1937, Rinonapoli[32] reported three cases. In 1938, Mondolfo[26] reported seven cases but attributed them to an inflammatory condition. In 1940, Jaffe and Lichtenstein[17] reported a total of 33 cases that they had observed. In the next seven years, numerous reports appeared.

In 1947, Sherman[34] found reports of 128 cases and added 30 that she had reviewed. Since then many additional cases have been reported, so that now we estimate the total at more than 300 cases of pathologically proved osteoid osteoma.

Although most authors writing on this subject have described the roentgenologic characteristics of the disease, they have generally emphasized the clinical and pathologic features. An exception is an article by Moberg[25] in 1952, in which an excellent roentgenologic analysis of the disease is presented.

MATERIAL AND METHOD

As a background for this study, a review was made of the roentgenograms and records of all the Mayo Clinic cases in which either a clinical or roentgenographic diagnosis of osteoid osteoma had been made. The study itself was based only on those cases in which pathologic proof was obtained. There were 52 such cases, and

* Abridgment of thesis submitted by Dr. Flaherty to the Faculty of the Graduate School of the University of Minnesota in partial fulfillment of the requirements for the degree of Master of Science in Radiology.

† The Mayo Foundation, Rochester, Minnesota, is a part of the Graduate School of the University of Minnesota.

roentgenograms were available in all but two. Thirty-five of these have been reported previously.[8,9,31,37,38]

CLINICAL FEATURES

The osteoid osteomas in this series were found most commonly in older children, adolescents and young adults. They were uncommon after the age of thirty-five years. The youngest patient was two years old, the oldest fifty-two. The age distribution (Table I) was approximately the same as that reported in the literature. Forty-one were males and 11 were females.

The bones most frequently involved were the femur and tibia (Table II). Next in order of frequency were other long bones, the ilium and the scapula. According to the literature, other favored sites are the phalanges, astragalus, calcaneus, vertebrae and carpal navicular.[11,15,27,34] One osteoid osteoma in our series arose in the body of the mandible (Fig. 1). The skull is the only location in which an osteoid osteoma has not yet been reported.

The diagnosis of osteoid osteoma was often suggested by the history. The duration of symptoms, although occasionally short or very long, was most often between six months and one year. The shortest duration was one week, the longest six years. Almost without exception the initial symptom was pain, vague at first but gradually increasing in severity. This pain was described as boring or aching in character and was often worse at night. In many cases it was completely relieved by aspirin. Sobel,[36] Pines and co-workers,[29] and Löfgren[20] have reported cases without pain. Only one patient in our series did not complain of pain. When an osteoid osteoma involved the lower extremity, a limp was frequently present. Kleinberg[18] has said that in children too young to complain of subjective symptoms, limp or awkward gait may first call attention to the disease.

Although many of the tumors produced symptoms that were localized to the immediate site of involvement, they not infrequently produced a more bizarre clinical picture. Of particular interest in this re-

TABLE I

AGE DISTRIBUTION OF PATIENTS

Age, Years	Patients
0–5	4
6–10	9
11–15	10
16–20	12
21–25	8
26–30	2
31–35	5
More than 35	2
Total	52

TABLE II

DISTRIBUTION OF CASES ACCORDING TO BONE INVOLVED

Bone Involved	Cases
Femur	21
Tibia	15
Humerus	4
Ilium	3
Ulna	2
Scapula	2
Fibula, calcaneus, astragalus, vertebra and mandible, 1 each	5
Total	52

FIG. 1. Roentgenographic appearance of osteoid osteoma of the mandible.

spect were the tumors that developed in the proximal part of the femoral shaft, femoral neck, ilium and scapula. In these locations there was a high incidence of referred pain or pain which simulated that of a protruded intervertebral disk.

Seven patients had tumors that involved the proximal part of the femoral shaft. Five of the seven had symptoms that resembled those of protruded intervertebral disk. Two of the five had previously undergone myelography and one had undergone exploratory laminectomy at the level of the fifth lumbar vertebra without relief of symptoms. Another patient in this group was referred to the clinic with a provisional diagnosis of cord tumor.

Seven patients had osteoid osteomas that arose in the femoral neck. Two of these had symptoms localized to the hip,, two had pain in the hip with referred pain to the knee, one had pain only in the knee and two had symptoms simulating protruded intervertebral disk. One of these patients had undergone myelography previously.

Three patients had tumors of the ilium. All three had symptoms of low back or gluteal pain, with extension down the homolateral extremity. Two had myelographic studies before the true nature of their difficulty was recognized.

Both patients with involvement of the scapula had pain that was referred to the arm. In addition, one of the four patients with an osteoid osteoma of the humerus had pain in the neck and arm which simulated root pain.

The most constant physical finding was tenderness localized to the site involved. This tenderness was usually slight or moderate, but occasionally exquisite. Local swelling was present in some instances, usually when a bone having little overlying soft tissue was involved but occasionally when a more deeply placed bone was affected. This local swelling was usually constant but in two cases it appeared intermittently during the course of the disease. When a bone was involved close to a joint, the swelling appeared to be associated with the joint and limitation of joint motion was sometimes noted. The local skin temperature was often increased but redness of the skin was seldom seen. Soft-tissue atrophy of part or all of an entire extremity was often present when the tumor arose in that extremity. This was a disuse atrophy, its extent being related to the duration and severity of the symptoms. The patients with osteoid osteoma who had symptoms suggesting a protruded intervertebral disk did not present physical findings to substantiate this diagnosis.

NATURAL HISTORY

The natural history of an osteoid osteoma is still much of a mystery. The cause is unknown and its propensity to induce sclerosis of adjacent bone is not understood. Jaffe[15] has expressed the belief that the lesion first appears on the roentgenogram as a small area of increased density of bone. The tumor has been observed to increase in size over periods varying from seven to sixteen months.[21,24,34] How long this growth continues and why it ceases are unknown. It has been suggested that the symptoms disappear after growth of the tumor stops, but our observations fail to bear this out. We have observed three cases in which the appearance of the tumor was unchanged on the roentgenogram for periods of six, seventeen, and twenty-four months respectively, but symptoms either remained unchanged or increased in severity.

The ultimate fate of these tumors in their natural cycle is even more uncertain. With a tumor that is so amenable to surgical excision and so difficult at times to distinguish from other lesions, it is reasonable and logical not to wait and observe what will ultimately happen to it. Sherman[34] has postulated that they must spontaneously regress, since they are uncommonly found after the age of thirty years. In several reported cases of what appeared to be typical osteoid osteoma the condition was not treated surgically,[9,11,34] yet after a period of years the symptoms

subsided. In one case the roentgenographic appearance remained unchanged. In another the nidus disappeared and in a third the bone returned to normal, the nidus disappearing first and then the reactive sclerosis.

PATHOLOGIC FEATURES

Pathologically the tumor nidus was distinctive. Grossly it was reddish gray to red, resembling granulation tissue. Usually it was less than a centimeter in its greatest dimension but sometimes it was larger, the largest measuring 2 cm. Surrounding bone was characteristically white and sclerotic.

In 1953, Jaffe[16] described the microscopic changes that occurred as a lesion evolved. At the site of the future nidus there were first increased vascularity and active reconstruction of bone. The osseous tissue then was resorbed and replaced by new bone which was prominent around blood vessels and atypical histologically. Eventually the mature nidus evolved.

Microscopically, all the osteoid osteomas of our series presented a characteristic picture. There was a background stroma of vascular fibrous tissue, the vascularity being more pronounced toward the periphery. Large numbers of young mesenchymal cells were scattered irregularly throughout this tissue, some displaying transitions to fibroblasts and osteoblasts. Giant osteoclasts were also present. Arising in this stroma was an irregular pattern of fine, interlacing osteoid trabeculae in which there were varying amounts of calcification. Osteoblasts were seen lined up along many of these trabeculae. Typical marrow was conspicuous by its absence (Fig. 2). The nidus was loosely attached to the surrounding sclerotic bone, the interstices of which were often fibrous and vascular.

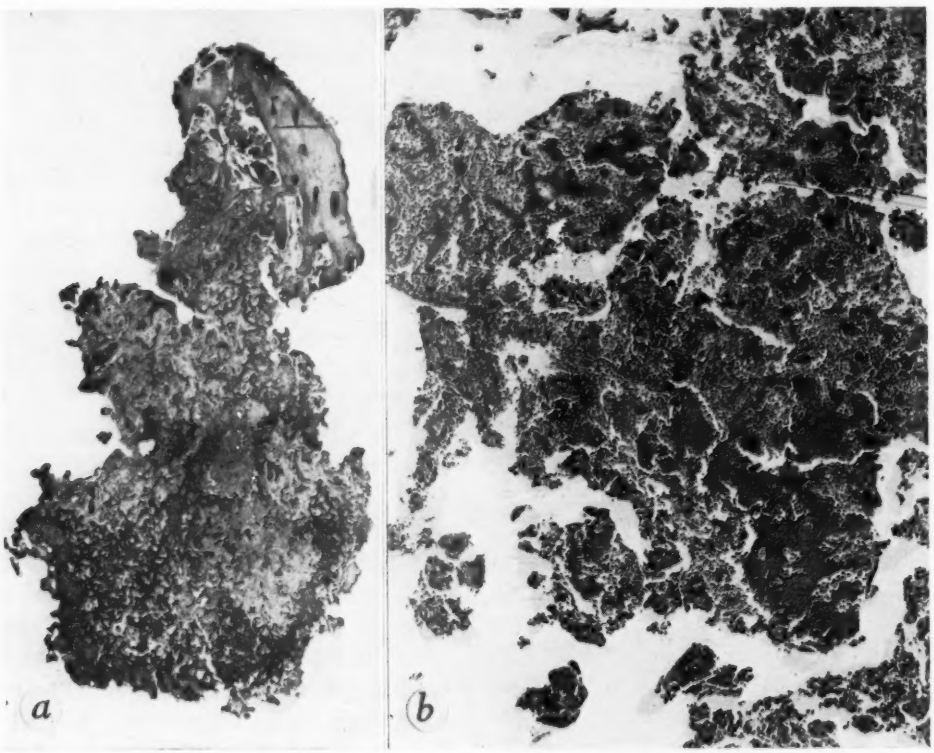


FIG. 2 (*a*) The entire tumor in the case represented in Figure 9. It demonstrates the characteristic pattern of irregular interlacing osteoid trabeculae (hematoxylin and eosin; ×10). (*b*) Osteoid osteoma showing irregular osteoid trabeculae in a cellular fibrous-tissue stroma (hematoxylin and eosin; ×40).

LABORATORY FINDINGS

Results of routine laboratory studies were normal in most cases. Leukocyte counts were slightly elevated in three of 47 cases. The sedimentation rate was increased in four of 46 cases, but in only one was this more than a slight increase. Cultures of surgical specimens were sterile in 13 of 15 cases, although two had growths of nonpathogenic organisms which were considered contaminants.

ROENTGENOGRAPHIC FINDINGS

The roentgenographic findings in our cases, being dependent on numerous factors, showed considerable variation. In most cases a nidus was seen in association with bony sclerosis or proliferation. Occasionally the reactive bone was the only obvious finding, and at times only the nidus without any apparent reactive bone was all that could be seen.

Some of the tumors were radiolucent while others presented varying amounts of calcification. When Jaffe[13] first described this tumor, he said that the nidus was radiolucent in its early stages and subsequently became calcified. In 1945, he[15] wrote that he had reason to believe that just the opposite was the case and that the radiolucent nidus represented the mature lesion. We believe that Jaffe's latter assumption is correct. Although no definite time relationship was found in our cases, it was observed that those tumors with roentgenographic evidence of calcification within them usually had a shorter clinical course than those without calcification. There was one exception to this. A patient in our series with symptoms for five years showed a rather densely calcified nidus. Because of this discrepancy we have wondered whether this might not represent a regressing phase of an osteoid osteoma. In one case the lesion was observed to change from a partially calcified one to a completely radiolucent one. In two patients observed for seventeen months and two years respectively, the nidus was originally radiolucent and remained so during these periods.

An osteoid osteoma has always been considered as presenting only one tumor or nidus in any one individual. Lapidus and Salem[19] reported a case in which they suspected two separate nidi in a femur, far removed from each other, but had pathologic proof of osteoid osteoma at only one site. In one case in our series there were three separate and distinct nidi, closely grouped. These separate nidi were identified roentgenologically and pathologically (Fig. 3).

Osteoid osteoma may arise in spongy bone, subcortically, within the cortex or beneath the periosteum. Symptoms can precede the development of any roentgenographic evidence of the tumor. The bony changes, when they occur, are usually local but they may be associated with osteoporosis of disuse. If the tumor is near a joint there may be a nonspecific inflam-

Fig. 3. Osteoid osteoma of the femur with three separate nidi. One is radiolucent while two contain calcium.

matory reaction within the joint and eventually roentgenographic evidence of degenerative disease of the joint. Sherman,[33] in 1947, reported two cases in which an osteoid osteoma that arose near a joint incited a nonspecific inflammatory reaction in the associated joint. In one of these cases roentgenographic evidence of degenerative disease of the joint developed. Three of our patients in whom the tumor was in the femoral neck presented roentgen evidence of early degenerative disease in the hip joint. In only one of these patients, however, could the joint changes be unmistakably attributed to the presence of the tumor. The other two had had operative procedures performed on the femoral neck which may have been an inciting factor.

Ponseti and Barta[30] reported instances in which the anatomic configuration of a bone was altered by the presence of an osteoid osteoma. We have observed three cases in which the normal anatomy of a bone was altered. In all, the tumor occurred during the growth period of the bone. In one the tumor arose near the distal tibial metaphysis and stimulated longitudinal growth of bone in this region (Fig. 4). In the other two the tumor arose in the femoral shaft and femoral neck and caused increased width of the bone.

FIG. 4. Osteoid osteoma of the tibia. Its presence has stimulated the growth of bone in the lateral portion of the distal tibial metaphysis.

The reaction of bone to the presence of an osteoid osteoma was observed to be dependent on the bone involved and the position of the tumor within the bone. When the tumor developed in spongy bone it was seen as a radiolucent or partially calcified, round or oval nidus. The surrounding bone was either normal in appearance or presented some degree of sclerosis. The distribution of this reactive bone was an interesting feature. At times the sclerosis affected the bone along only a portion of the circumference of the tumor, but at other times it completely surrounded the nidus. It was usually uneven in its distribution, with some areas extending farther from the nidus than others. It was occasionally so faint that a slight difference in roentgenographic technique was critical in determining whether sclerosis was or was not present. It infrequently formed a narrow dense shell around the tumor.

The osteoid osteomas that arose in or adjacent to the cortex of bones that had only a small surface covered by periosteum usually stimulated little if any periosteal new-bone formation (Fig. 5). In a location such as this, the cortex, rather than being thickened, has been reported as being eroded, expanded or elevated by the tumor.[10,12,36] In our series, few tumors involved the hand or foot, but from the examples in the literature we believe that such tumors illustrate the relationship between the amount of periosteum and the roentgenographic appearance.[4,7,25] When a metacarpal or metatarsal bone was involved, there was usually considerable periosteal new-bone formation; this became less as the phalanges were involved. In the distal phalanx and in the carpal or tarsal bones little or no periosteal new bone developed.

The most common site of origin of the tumor in our series was in the diaphysis of long bones. The tumor was usually oval-shaped and was found subcortically, within the cortex, beneath the periosteum and

Fig. 5. Osteoid osteoma arising in the neck of the astragalus and producing elevation of the cortex, little periosteal new bone and slight sclerosis of the contiguous spongy bone. This is a common site for this tumor when it arises in the astragalus.

occasionally in the spongy bone. The most constant roentgenographic finding was cortical thickening. It was often marked, extending around the shaft and for some distance up and down the bone. This periosteal new bone was as much as 3 or 4 cm. thick. It assumed a tapering or fusiform appearance, the thickest portion usually being centered over the nidus. Because of the thickness of this new bone, it was necessary at times to utilize heavy-exposure techniques or laminagraphy to see the nidus. Frequently, however, there was only a small amount of cortical thickening or this cortical thickening was irregular in appearance. In several of our cases the cortical thickening looked like a flat exostosis.

No relationship was found between the amount of cortical thickening and the duration of symptoms. Often a tumor with a long clinical history produced minimal cortical reaction, while a tumor with a short clinical history produced extensive periosteal new-bone formation. Because of the abundant new-bone formation and lack of tangential roentgenograms in some of our cases, it was difficult to determine the exact position of the nidus in relation to the cortex in all cases. Of the tumors in which the nidus was localized, it was found that as a general rule those which arose beneath the periosteum produced the most new-bone formation, those within the cortex a lesser amount and those beneath the cortex the least.

This new bone had a laminated appearance in the roentgenogram in seven of our cases. The lamination was present in those patients with a short clinical history, a large amount of new-bone formation and a relatively large nidus. It was associated with tumors that arose subcortically, as well as with those that arose beneath the periosteum.

In the tumors of long bones, sclerosis of the spongy bone was infrequently seen, even when development of periosteal new bone was extensive. The spongy bone of the medullary space often presented a false roentgenographic appearance of sclerosis owing to the thickened cortex around the shaft. When true sclerosis did occur, it usually was associated with those tumors that arose beneath the cortex.

Erosion of the cortex, which is common when the osteoid osteoma involves a small bone, can also occur in the cortex of a long bone if the tumor is large. Two tumors in this series, which originated subcortically in long bones, produced erosion of the cortex (Fig. 6).

The osteoid osteomas that developed in or adjacent to the cortex near the end of a tubular bone stimulated the formation of periosteal new bone which, being limited by the extent of the periosteum, was eccentrically located. In these cases the nidus was not at the central point of the reactive bone but was toward one end. In all but one of this type the nidus was clearly seen.

Of the seven osteoid osteomas that originated in the femoral neck, one arose in the spongy bone and five in the immediate subcortical area; the exact site of origin of the seventh tumor could not be determined roentgenographically because of the

FIG. 6. Large osteoid osteoma which has eroded through the cortex of the femur.

changes resulting from prior surgical treatment. The tumor that arose in spongy bone was accompanied by minimal sclerosis. Three tumors arose along the inferior border of the femoral neck. They produced roentgenographic changes that were rather distinctive of an osteoid osteoma in that region (Fig. 7); the nidus was clearly seen in all, and the cortex was thickened beneath the nidus. The other two tumors that developed beneath the cortex were not as readily detectable. They arose beneath the posterior cortex of the femoral neck and produced only a radiolucent area in the anteroposterior view (Fig. 8). Lateral views, however, demonstrated cortical thickening over the tumors.

DIFFERENTIAL DIAGNOSIS

On roentgenographic appearance alone, it may be quite difficult at times to distinguish an osteoid osteoma from a number of other bone diseases. The history and physical findings are often a great help in arriving at the correct diagnosis.

FIG. 7. Osteoid osteoma which has arisen subcortically in the right femoral neck. Note the thickening of the inferior border of the neck and the minimal sclerosis in the contiguous spongy bone. There are also widening of the femoral neck and generalized osteoporosis of the right innominate bone and femur.

Sclerosing osteomyelitis of Garré may be confused with an osteoid osteoma in the roentgenogram. Usually, however, this type of osteomyelitis produces an irregular thickening of the cortex and considerable reactive sclerosis in the spongy bone. In many cases a large portion of the shaft of a

FIG. 8. Osteoid osteoma which arose subcortically on the posterior surface of the femoral neck in an eighteen year old person. There is early degenerative disease of the hip joint.

bone is involved. Necrosis and rarefaction of bone seldom occur. Osteoid osteomas differ in that sclerosis of medullary bone is not a prominent feature and a definite nidus is usually seen.

A small pyogenic abscess in cortical bone may simulate osteoid osteoma roentgenographically.[2,3] It has been said that in this type of osteomyelitis the periosteal new-bone formation is less, in relation to the size of the central radiolucent area, than in osteoid osteoma and that when a cortical abscess stimulates new-bone formation the new bone is usually more irregularly laid down than that found in osteoid osteoma. Noting the great variation in cortical reaction in the osteoid osteomas in our series, we hesitate to differentiate the two on the basis of such reaction. We believe that they are often impossible to differentiate roentgenographically.

The roentgen appearance of a small localized area of tuberculous or brucellar osteomyelitis also may be identical to that of osteoid osteoma.

Osteoid osteoma may be difficult to distinguish from Ewing's tumor when the latter is small and has produced only minimal destruction of bone and a minimal amount of periosteal new bone. Usually, however, Ewing's tumor is seen in a more advanced stage, when destruction of bone is a prominent feature.

In one case in our series the tumor resembled osteogenic sarcoma (Fig. 9). It arose in the region of the lesser trochanter. The roentgenogram showed formation of periosteal new bone with slight formation of spicula. A nidus was not seen. These spicula appeared broader, shorter and blunter than those usually seen in osteogenic sarcoma but a malignant tumor had to be included in the differential diagnosis.

The osseous lesions of reticuloendotheliosis may possibly be confused with a radiolucent nidus unassociated with sclerosis. However, the lesions of reticuloendotheliosis are ordinarily larger when seen initially and are often multiple.

A march fracture of the metatarsal, fibula or tibia may have a roentgen appearance similar to that of an osteoid osteoma. A nidus is not present, however, and often a fracture line can be seen.

It would seem, from Jaffe's[15] description of the small rod-shaped sclerotic osteoid osteoma, that a differential diagnosis between this type and a small enostosis would

Fig. 9. Osteoid osteoma of the femur near the lesser trochanter simulating a malignant tumor.

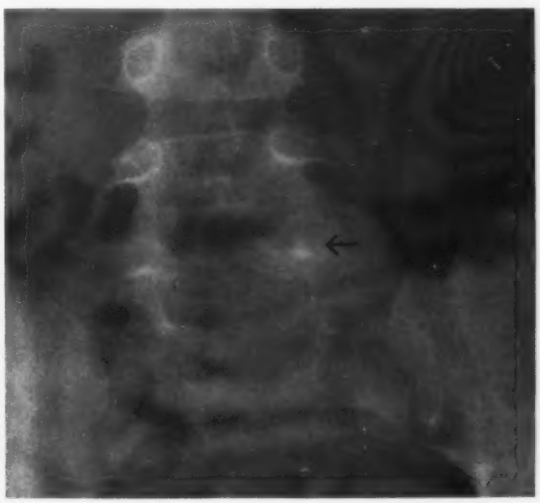


Fig. 10. Giant osteoid osteoma arising in the left pedicle of the fifth lumbar vertebra. This roentgenogram was taken two months after onset of symptoms. The appearance of the lesion at this time is indistinguishable from that of an ordinary osteoid osteoma. In the following eight months the tumor increased rapidly in size.

be quite difficult on a purely roentgenographic basis. Sherman[35] has reported a case in which just such a small island of bone was removed on the assumption that it was an early osteoid osteoma. However, as Sherman pointed out, the history and physical findings were not compatible with osteoid osteoma.

Dahlin and Johnson[6] recently described a large benign osteoid-forming tumor that they termed "giant osteoid osteoma." Their cases are not included in our report. Microscopically these tumors differed from an osteoid osteoma in that they had broader, longer and more widely separated osteoid trabeculae. In two of their cases roentgenograms made during an early stage of the disease were available. Both tumors passed through a stage in their development in which they were indistinguishable from osteoid osteoma (Fig. 10).

SUMMARY AND CONCLUSIONS

The present report concerns 52 cases of pathologically proved osteoid osteoma, a benign neoplasm of bone characterized in the roentgenogram by a small tumor nidus that is usually accompanied by a variable amount of contiguous bony sclerosis or the formation of periosteal new bone. The symptoms and physical findings were usually local, but when the tumor arose in the proximal part of the femur and in the ilium, the incidence of referred pain or pain simulating that of a protruded intervertebral disk was high.

Osteoid osteoma, early in its development, probably appears on the roentgenogram as a small area of radiopacity which later becomes partially or completely radiolucent. The presence or absence of calcification within the tumor does not appear to be significant, except as an aid in differential diagnosis.

The type and amount of reactive bone formation accompanying the tumor and hence the appearance of the lesion were variable. They were dependent on the bone involved and the position of the tumor within the bone.

Mayo Clinic
Rochester, Minnesota

REFERENCES

1. BERGSTRAND, H. Über eine eigenartige, wahrscheinlich bisher nicht beschriebene osteoblastische Krankheit in den langen Knochen der Hand und des Fusses. *Acta radiol.*, 1930, *11*, 596–613.
2. BRAILSFORD, J. F. Chronic sub-periosteal abscess. *Brit. J. Radiol.*, 1942, n.s. *15*, 313–317.
3. BROWN, R. C., and GHORMLEY, R. K. Solitary eccentric (cortical) abscess in bone. *Surgery*, 1943, *14*, 541–553.
4. CARROLL, R. E. Osteoid osteoma in hand. *J. Bone & Joint Surg.*, 1953, *35-A*, 888–893.
5. COMPERE, E. L. Streptococcus viridans osteomyelitis. *J. Bone & Joint Surg.*, 1932, n.s. *14*, 244–258.
6. DAHLIN, D. C., and JOHNSON, E. W., JR. Giant osteoid osteoma. *J. Bone & Joint Surg.*, 1954, *36-A*, 559–572.
7. DE GÕES, HENRIQUE. Osteoma osteóide. *Rev. brasil. de cir.*, 1948, *17*, 89–96.
8. DOCKERTY, M. B. Certain small painful tumors of extremity. *Journal-Lancet*, 1953, *73*, 57–62.
9. DOCKERTY, M. B., GHORMLEY, R. K., and JACKSON, A. E. Osteoid osteoma; clinicopathologic study of 20 cases. *Ann. Surg.*, 1951, *133*, 77–89.
10. FAGERBERG, STIG, and RUDSTRÖM, P. Osteoid osteoma of vertebral arch; case report. *Acta radiol.*, 1953, *40*, 383–386.
11. GOLDING, J. S. R. Natural history of osteoid osteoma; with report of twenty cases. *J. Bone & Joint Surg.*, 1954, *36-B*, 218–229.
12. HORWITZ, T. Case reports; osteoid-osteoma of astragalus. *Radiology*, 1942, *39*, 226–228.
13. JAFFE, H. L. "Osteoid-osteoma." Benign osteoblastic tumor composed of osteoid and atypical bone. *Arch. Surg.*, 1935, *31*, 709–728.
14. JAFFE, H. L. Osteoid osteoma. (Abstr.) *Am. J. Path.*, 1936, *12*, 796–797.
15. JAFFE, H. L. Osteoid-osteoma of bone. *Radiology*, 1945, *45*, 319–334.
16. JAFFE, H. L. Osteoid-osteoma. *Proc. Roy. Soc. Med.*, 1953, *46*, 1007–1012.
17. JAFFE, H. L., and LICHTENSTEIN, L. Osteoid-osteoma: Further experience with this benign tumor of bone; with special reference to cases showing lesion in relation to shaft cortices and commonly misclassified as instances of sclerosing non-suppurative osteomyelitis or cortical-bone abscess. *J. Bone & Joint Surg.*, 1940, n.s. *22*, 645–682.

18. KLEINBERG, S. Osteoid-osteoma; report of five cases. *New York State J. Med.*, 1943, *43*, 332-338.
19. LAPIDUS, P. W., and SALEM, E. P. Osteoid osteoma; report of case with probable double lesion. *Arch. Surg.*, 1949, *58*, 318–327.
20. LÖFGREN, L. "Osteoid-osteoma." *Acta chir. scandinav.*, 1953, *104*, 383–404.
21. MACKENZIE, W. Painful, non-suppurative, localized sclerosis of long bones; with report of two cases. *J. Bone & Joint Surg.*, 1947, n.s. *29*, 49–58.
22. MARZIANI, R. Quoted by Jackson, A. E. Osteoid osteoma. Thesis, Graduate School, University of Minnesota, 1948.
23. MILCH, H. Osteoid-tissue-forming tumor simulating annular sequestrum. *J. Bone & Joint Surg.*, 1934, n.s. *16*, 681–688.
24. MOBERG, E. The natural course of osteoid osteoma. *J. Bone & Joint Surg.*, 1951, *33-A*, 166–170.
25. MOBERG, E. Further observations on "corticalisosteoide" or "osteoid osteoma." *Acta radiol.*, 1952, *38*, 279–293.
26. MONDOLFO, S. Osservazioni cliniche ed anatomo-istologiche sull'infiammazione primitiva cronica della spongiosa ossea. *Chir. d. org. di movimento*, 1938, *24*, 133–147.
27. MORRISON, G. M., HAWES, L. E., and SACCO, J. J. Incomplete removal of osteoid-osteoma. *Am. J. Surg.*, 1950, *80*, 476–481.
28. PHEMISTER, D. B. Chronic fibrous osteomyelitis. *Ann. Surg.*, 1929, *90*, 756–764.
29. PINES, BERNARD, LAVINE, LEROY and GRAYZEL, D. M. Osteoid osteoma: Etiology and pathogenesis; report of twelve new cases. *J. Internat. Coll. Surgeons*, 1950, *13*, 249–277.
30. PONSETI, I., and BARTA, C. K. Osteoid osteoma. *J. Bone & Joint Surg.*, 1947, n.s. *29*, 767–776.
31. PURCELL, H. M., MILLS, S. D., and LIPSCOMB, P. R. Osteoid osteoma in childhood. *Pediatrics*, 1952, *9*, 295–303.
32. RINONAPOLI, G. Osteoma-osteoide. *Arch. di med. e chir.* (Milan), 1937, *6*, 517–538.
33. SHERMAN, MARY S. Osteoid osteoma associated with changes in adjacent joints; report of two cases. *J. Bone & Joint Surg.*, 1947, n.s.*29*, 483–490.
34. SHERMAN, MARY S. Osteoid osteoma; review of literature and report of thirty cases. *J. Bone & Joint Surg.*, 1947, n.s. *29*, 918–930.
35. SHERMAN, MARY. Differential diagnosis of osteoid osteoma. *J. Louisiana M. Soc.*, 1953, *105*, 469–474.
36. SOBEL, R. Osteoid-osteoma; report of 2 cases and review of pertinent literature. *Bull. Hosp. Joint Dis.*, 1946, *7*, 94–98.
37. YOUNG, H. H. Non-neurological lesions simulating protruded intervertebral disk. *J.A.M.A.*, 1952, *148*, 1101–1105.
38. YOUNG, H. H. Additional lesions simulating protruded intervetebral disc. *J. Internat. Coll. Surgeons*, 1952, *17*, 831–839.
39. ZANOLI, R. Osteopatia post-traumatica del grand'osso. *Arch. di med. e chir.* (Milan), 1935, *4*, 653–658.

OSSEOUS COCCIDIOIDOMYCOSIS*

A CHRONIC FORM OF DISSEMINATION

By J. W. BIRSNER, M.D., *and* SCOTT SMART, M.D.
BAKERSFIELD, CALIFORNIA

OSSEOUS coccidioidomycosis occurs as a dissemination of the disease. In our opinion it is a chronic, self-limiting disease which rarely ends fatally unless there is also generalized systemic involvement. This series of 18 cases is unique since review of the medical literature shows it represents the first long term follow-up in osseous coccidioidomycosis. The cases in this series have been followed from four to twenty-nine years.

Despite the fact that there are well over 300 publications dealing with various phases of coccidioidomycosis, there has been a scarcity of information regarding the osseous form of dissemination. The first reported case was from Buenos Aires in 1892 and 1900. The second and third cases were reported from California in 1894. In 1931 Carter[2] published the first satisfactory roentgen analysis of osseous coccidioidomycosis. Since then the literature has consisted primarily of roentgenologic studies and collected material from various large general hospitals as well as of isolated case reports of lesions of coexisting fungus infections occurring in the same bone. The exceptions are the publications by Benninghoven and Miller[1] in 1942, Miller and Birsner[8] in 1949, and Dykes, Segesman and Birsner[7] in 1953.

Table 1 presents the 18 cases in summarized form. These patients were contacted through the facilities of the Kern County Public Health Department and the Kern General Hospital Medical Records Librarian.

Figures 1 to 14 illustrate the types of osseous involvement encountered. In several instances comparative views are presented so that the osteoblastic as well as the osteolytic process can be observed.

A few of the more interesting cases are reported in brief form.

REPORT OF CASES

CASE 1. This white male patient was twenty-six years old when he contracted coccidioidomycosis with osseous dissemination twenty-eight and one-half years ago while working as a welder on the railroad. Draining sinuses appeared on his forehead, left cheek, left heel, both sides of the pelvis, right shoulder and right elbow. *C. immitis* was recovered from biopsy specimen from abscess. Roentgenograms revealed involvement of the facial bones, right wrist, left calcaneus, pelvis and right scapula. The patient was treated with Chalmugra oil for six weeks without benefit. About five years after onset of draining sinuses, they were entirely healed and there has been no recurrence. Multiple skin dimples mark the sites of previous drainage. Recent roentgenograms of the involved bones demonstrated rarified cystic areas in the skull (Fig. 1) and left calcaneus (Fig. 2) with fusion and sclerosis of the right wrist (Fig. 3). These findings were un-

FIG. 1. Case 1. Rarefied cystic area in skull twenty-eight and one-half years after onset of disease.

* From the Department of Radiology, Kern General Hospital, Bakersfield, California.

Fig. 2. Case 1. Rarefied cystic area in calcaneus twenty-eight and one-half years after onset.

changed since the last roentgenograms were taken six years ago. This patient owns his own store and is working full time. His only residual lesion is moderate arthritis of his right wrist.

Case II. Twenty-one and one-half years ago, this colored male at the age of fourteen presented symptoms of pain in the lumbar region and swelling on the left side of the spine. There was no history of preceding injury and no respiratory symptoms. Roentgenograms of the pelvis showed the crest of the left ilium destroyed with the borders fairly sharp and no evidence of bone proliferation. One year later *C. immitis* was recovered from an abscess that developed in the left groin. No specific treatment was given. The abscess closed and the patient had no further trouble during the next thirteen years. Then, while serving in the army, he developed "boils" under his right arm and left knee; these later closed. The patient has had no further difficulty since then and is working full time as a mail carrier.

Case IV. Eighteen years ago a two year old colored girl entered the hospital with a swelling of the right forearm and swelling above the right eye of about one month's duration. Coccidioidin skin test was positive and *C. immitis* was recovered from a cyst above the right eye. A few months later a spinal deformity was noticed, and one year after onset of symptoms, roentgenograms of the spine revealed destruction of T 12 and L 1. No treatment except bed rest was given until eight years after onset of symptoms when a spinal fusion was performed. Eighteen months later roentgenograms of the skull revealed sclerosis of the anterior portion of the left orbital ridge. The recurrent cyst above the left eye was excised

Fig. 3. Case 1. Fusion and sclerosis of right wrist twenty-eight and one-half years after onset.

TABLE I

Case	Age at Onset	Duration of Disease	First Symptom	Interval First Symptom to Known Bone Involvement	Occupation	Bones Involved	Complement Fixation Tests	Laboratory Findings	Treatment	Present Condition
I M/W	26	28 yrs 5 mo.	Headache	2 weeks	Welder on railroad	Facial bones; rt. wrist; lt. calcaneus; pelvis; rt. scapula	1941 4+@1:16 1954 3+@1:32	Biopsy of abscess pos. *C. immitis*	Chalmugra oil 6 weeks. No benefit. Sinuses healed in 5 years	Works full time storekeeper
II M/Col.	14	21 yr. 6 mo.	Pain and swelling lumbar region	Unknown. Roentgenogram 1933 showed crest lt. ilium destroyed	Student	Crest of lt. ilium	1954 1+@1:2	Smear and cult from abscess lt. groin pos. *C. immitis*	None. Lesions closed. No trouble until 1947; drainage rt. arm 1 year, now closed	Works full time, mail carrier
III M/Col.	6	21 yr. 7 mo.	Swelling rt. groin	Unknown	Child	Lumbar spine	1946 4+@1:16 1947 1+@1:256 1952 1+@1:256	Cult. pos. from sinus on lt. leg	1946 roentgen therapy to pelvis and thigh with decrease of drainage	Works full time, general laborer
IV F/Col.	2	18 yr. 1 mo.	Swelling rt. forearm and rt. forehead	7 months. Scoliosis in spine	Child	T12 and L1	1954 3+@1:32	1936 skin test pos. 1945 pos. smear. Abscess over lt. eye	Bed rest; 1944 spinal fusion	Works full time, housework; kyphosis lower spine
V F/W	56	10 yr. 11 mo.	Swelling dorsum left foot	Unknown	Tomato picker	Lt. metatarsals	1954 3+@1:128	1948 neg skin test. Pos. cult. lt. metatarsal	Leg cast 6 mo.; no value; drainage continued	Unable to work; draining sinus lt. foot
VI F/Col.	16	10 yr. 7 mo.	Chest pain and cough	1 mo. draining sinus rt. hand	Student	Rt. mandible; rt 4th metacarpal	1954 3+@1:16	1944 pos. cult. from sinuses	Bed rest; areas stopped draining in 1 year	Works full time, housewife
VII M/Col.	13	8 yr. 11 mo.	Swelling left wrist	Unknown	Student	Left 2nd metacarpal; lt. 5th metatarsal	1947 4+@1:32 1954 3+@1:16	1946 neg. skin test. 1947 smear pos. lt. 2nd metacarpal	Bed rest; little benefit	Works full time, aircraft assembler; soft tissue abscess lt. neck with drainage
VIII M/W	26	7 yr. 11 mo.	Swelling rt. ant. chest following car accident	Unknown	Garage worker	Rt. ant. 3rd rib; lt. ankle	1947 3+@1:16 1954 3+@1:16	1948 cult. abscess ant. chest pos.	None	Works full time, insurance agent; arthritis lt. ankle
IX F/Col.	51	7 yr. 2 mo.	Swelling over sternum	Unknown	Housewife	Manubrium	1948 1+@1:128 1951 2+@1:64 1954 1+@1:4	1948 cult. pos. from sternal sinus	Roentgen therapy to sternum; closed in a few months	Full activity, housewife

X M/Fil.	36	8 yr.	Swelling tarsal area lt. foot	Unknown	Field worker	Lt. tarsal navicular; lt. patella	1952 2+@1:32	1947 excised lt. tarsal navicular smear and cult. pos.	Partial surgical excision	Works part time; no further drainage
XI F/W	2 wks.	6 yr. 10 mo.	Respiratory infection	2 weeks swelling rt. 4th finger	Infant	Right fourth phalanges	1949 4+@1:16 1952 2+@1:4 1954 1+@1:2	1948 pos. smear and cult. from finger	Amputation rt. 4th finger	Full time student
XII M/W	29	6 yr. 9 mo.	Chest pain	2 months pain and drainage lt. foot	Day laborer	Lt. 2nd metatarsal; lt. patella	1954 3+@1:32	1948 cult. pos. from foot	Bed rest; 5 weeks	Works full time, office worker
XIII F/Col.	4	6 yr. 7 mo.	Swelling under rt. orbit	Unknown	Child	Rt. zygoma	1948 2+@1:64 1954 2+@1:32	1948 cult. from sinus positive	Chemotherapy	Full time student
XIV F/Mex.	5½	5 yr. 2 mo.	Cough and swelling rt. 4th toe	Unknown	Child	Rt. 4th toe	1944 2+@1:32 1950 3+@1:128 1954 3+@1:16	1949 aspir. and cult. toe positive	None; bed rest short time	Full time student
XV F/W	55	6 yr. 5 mo.	Cough, chest pain, malaise	11 months then pain lt. foot	Housewife	Lt. 2nd metatarsal, distal joint space	1948 Pos. precip. neg. comp. 1952 1+@1:128 1954 4+@1:128	No biopsy	None; bed rest	Full time work, housewife; residual coccidioma in lung
XVI M/Col.	13	4 yr. 7 mo.	Drainage from finger	7 months	Student	Rt. 4th finger, rt. 4th metacarpal	1951 2+@1:16 1954 2+@1:4	1951 smear and cult. positive	1951 amputation of finger	Full time college student; soft tissue abscess lt. elbow
XVII M/Col.	12	4 yr. 6 mo.	Swelling rt. post. chest	2 weeks	Student	Post. rt. 10th rib; 1953 rt. frontal bone	1950 1+@1:64 and 4+ precip. 1953 2+@1:32	1950 aspiration and cult. from chest positive	Bed rest and chemotherapy	Full time student
XVIII M/Col.	31	4 yr. 4 mo.	Pain rt. chest, cough and fever	1 month; draining sinuses	Construction worker	Rt. radius	1950 3+@1:32 1951 3+@1:128 1954 3+@1:32	1951 cult. from skin abscesses positive	Chemotherapy	Works full time, construction worker

FIG. 4. Case III. Involvement of anterior portion of the bodies of L_3, L_4, and L_5. Unchanged in ten years; apparently stable process.

and demonstrated *C. immitis*. The patient has had no further drainage or difficulty since that time (seven years) and is doing housework full time. She has some residual kyphosis in the lower dorsal spine.

CASE X. Two months after an injury to his left foot (eight years ago) a thirty-five year old man (Filipino) noticed swelling on the dorsal surface of the foot. The swelling increased until it extended from the toes to above the ankle. Roentgenograms showed a radiolucent area on the medial surface of the left tarsal navicular. Shortly thereafter a draining sinus appeared, and one month later a partial excision of the left navicular was performed. Purulent discharge was encountered and granulation tissue with *C. immitis* was demonstrated microscopically. The postoperative course was uneventful. Roentgenograms of the left knee at this time demonstrated a radiolucent area in the left patella. Roentgenograms six months later showed considerable recalcification of both the patella and the left tarsal navicular. The patient then moved to another county, but when contacted for this study, he reported there had been no further drainage. Recent roentgenograms showed still further recalcification of both the patella and left tarsal navicular.

CASE XI. About seven years ago this white female was born during a dust storm. When two weeks old, she developed a respiratory infection. In two more weeks there was swelling of the right fourth finger which rapidly increased in size. Roentgenograms showed destructive, expansile osteolysis in the middle phalanx (Fig. 6). Biopsy examination revealed *C. immitis*. Six months after onset of symptoms the right fourth finger was amputated; the postoperative course was uneventful. Recent

FIG. 5. Case VI. Right 4th metacarpal, ten and one-half years after onset of disease.

FIG. 6. Case XI. Right 4th finger; amputated six and one-half years ago. No further involvement.

FIG. 7. Case VII. Left 2nd metacarpal at onset of disease.

FIG. 8. Case VII. Left 2nd metacarpal eight years later; no drainage for five years.

FIG. 9. Case XV. Right 2nd metatarsal at onset of disease.

FIG. 10. Case XV. Right 2nd metatarsal four years later.

roentgenograms revealed some osteoporosis of the distal portion of the right fourth metacarpal but no evidence of further osseous involvement. This child is now a full time student and has had no further difficulty.

CASE XV. About six and one-half years ago this white female, aged fifty-five, developed cough, malaise and chest pain. Roentgenograms demonstrated bilateral infiltrations in both bases with minimal effusion on the left. Complement fixation test was negative, but precipitins were positive. Eleven months later the patient developed pain in the left foot. Roentgenograms revealed involvement of the joint space between the metatarsal and proximal phalanx of the left second toe (Fig. 9). The complement fixation test was then positive. Roentgenograms four years later revealed that the area of involvement remained sclerosed and was without repair (Fig. 10). A roentgenogram of the chest demonstrated a large coccidioma in the lower left lung field. This patient is a housewife and is working full time.

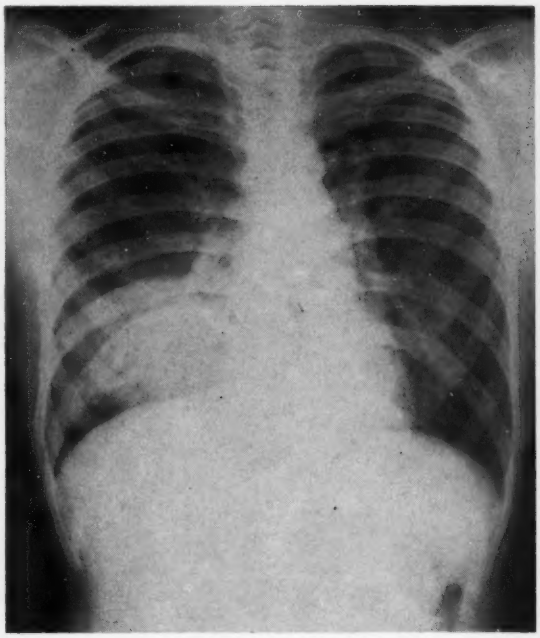


FIG. 11. Case XVII. Right 10th rib at onset of disease.

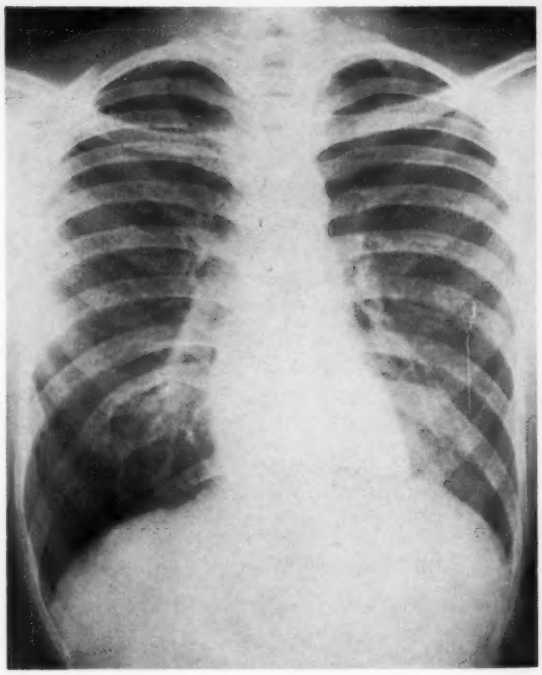


FIG. 12. Case XVII. Right 10th rib four years later.

DISCUSSION

Dissemination occurs in a very small percentage of the proved cases of coccidioidomycosis; however, on autopsy examina-

Fig. 13. Case xviii. Right radius at onset of disease.

Fig. 14. Case xviii. Right radius four years later; no drainage for three years.

tion, *C. immitis* has been found in every organ of the body. Hundreds of cases of disseminated coccidioidomycosis have been observed at Kern General Hospital during the past twenty-five years. The greater percentage of these patients had generalized systemic involvement instead of or in addition to osseous involvement. The cases presented here are limited strictly to the chronic form of osseous coccidioidomycosis.

The only significant portal of entry is through the respiratory tract and pulmonary symptoms usually appear in eight to twenty-one days. However, it is not unusual to find an absence of pulmonary pathology, the first symptoms being soft tissue swelling with bone involvement. In this series 8 patients had no discernible pulmonary pathology, either clinically or roentgenologically, at the time of the onset of osseous dissemination. In the other 10 patients there was no subsequent fibrosis, hilar adenopathy or cavitation, and only one patient had residual lung pathology consisting of a solid coccidioma. In no instance were we able to prove osseous coccidioidomycosis by direct inoculation.

The skin test is of little value in identifying osseous coccidioidomycosis. Frequently the patient develops an anergy and the skin test will remain negative in all dilutions. In all cases except one, *C. immitis* was recovered from biopsy specimen or smear and culture from abscess drainage. In the excepted case, an exploratory operation was proposed in order to rule out bone tumor and establish a diagnosis; however, the positive complement fixation test helped determine the diagnosis. In all cases the complement fixation tests were

positive and all of the patients still carry positive complement fixation tests in significant titer (see Table 1).

In this series the sites of predilection in order of frequency were (1) distal portions of the extremities, (2) bones of the trunk and (3) facial bones. This is dissimilar to those found by other authors.[1]

All types of treatment were employed including bed rest, roentgen therapy, chemotherapy and surgery (see Table 1). Insufficient evidence exists to decide whether surgery is a satisfactory method of treatment. Frequently when an excision or amputation is done, no subsequent spread occurs.

Careful review of Cohen and co-workers' reports[3–6] on the use of actidione, sodium caprylate, ethyl vanillate, fracidin, thiobitin, stilbamidine, rimacidin and para-amino-benzoic acid leads us to feel that the effect of treatment by these drugs is primarily psychosomatic. Continued search for a new and satisfactory fungicide is extremely commendable; however, we in the endemic area feel there is no medication used in the past or present that has proved satisfactory.

Apparently the most favorable prognosis can be expected when only one or two bones are involved. In this series 6 patients had involvement of one bone, in 9 patients two bones were involved and in the other 3 patients there were more than two bones involved. Roentgenograms demonstrated an osteolysis with or without cortical thickening and sclerosis. The involvement was frequently in the medullary portion of the bone and is believed to be hematogenous to bone rather than by direct extension from soft tissue. Although soft tissue involvement may occur without apparent bone spread, no case of subsequent bone invasion from a soft tissue focus was found. Thus again we were unable to confirm the observation of Carter[2] who reported that osseous involvement occurs by direct extension of the soft tissue abscess.

SUMMARY

A series of 18 cases of chronic osseous coccidioidomycosis with a follow-up of from four to twenty-nine years is presented.

The age range at time of onset is from two weeks to fifty-six years and all but one of the patients have returned to full activity.

Roentgenograms demonstrate an osteolysis with or without cortical thickening and sclerosis; the involvement is frequently in the medullary portion of the bone and is believed to be hematogenous to bone rather than by direct extension from soft tissue.

Despite prolonged search for a satisfactory fungicide, there is as yet no known medical treatment for osseous coccidioidomycosis; however, frequently good results have been obtained when surgical excision or amputation could be performed.

J. W. Birsner, M.D.
1705 27th Street
Bakersfield, California

REFERENCES

1. BENNINGHOVEN, C. D., and MILLER, E. R. Coccidioidal infection in bone, *Radiology*, 1942, *38*, 663–666.
2. CARTER, R. A. Coccidioidal granuloma: Roentgen diagnosis. AM. J. ROENTGENOL. & RAD. THERAPY, 1931, *25*, 715–738.
3. COHEN, R., and GIFFORD, M. A proven case of cured disseminated coccidioidomycosis. *Arch. Pediat.*, 1953, *70*, 81–88.
4. COHEN, R. Four new fungicides for Coccidioides immitis: Sodium caprylate, ethyle vanillate, fracidin and thiobitin, *Arch. Pediat.*, 1951, *68*, 259–264.
5. COHEN, R., and BOS, J. Two new fungicides for Coccidioides immitis (Stilbamidine and Rimacidin). *Arch. Pediat.*, 1952, *69*, 33–35.
6. COHEN, R., and O'CONNOR, R. Para-aminobenzoic acid as a fungicide for Coccidioides immitis. *Arch. Pediat.*, 1953, *70*, 404–405.
7. DYKES, J., SEGESMAN, J. K., and BIRSNER, J. W. Coccidioidomycosis of bone in children. *A.M.A. Am. J. Dis. Child.*, 1953, *85*, 34–42.
8. MILLER, D., and BIRSNER, J. W. Coccidioidal granuloma of bone. AM. J. OF ROENTGENOL. & RAD. THERAPY, 1949, *62*, 229–236.

Vol. 76, No. 6

THE MIGRATION OF A FRACTURE-TRANSFIXING PIN FROM THE HUMERUS INTO THE MEDIASTINUM*

By MICHAEL BURMAN, M.D., SOL GROSSMAN, M.D., *and* STEFAN ROSENAK, M.D.
NEW YORK, NEW YORK

THE pins which transfix the fragments of broken bones are often blindly introduced by puncturing the skin with the sharp tip of the pin. The blindness of insertion is mitigated by orientation with reference to given bony landmarks to achieve reasonably accurate placement of pin or pins. The pin ends which jut beyond the skin are cut close to the surface of the skin, subcutaneous position being assured by stretching the convexity of the skin flat. There are no operative scars and the puncture holes are sealed with collodion.

The method has the advantage of simplicity but there are certain known disadvantages of which two often occur. If the pins do not subsequently backtrack, a painful bursa over their lateral subcutaneous ends may demand later withdrawal. There are several ways to fix the pin but these demand incision. The fixation of Knowles wires is an example.

The significant medial migration of a pin is uncommon. Two cases are given, one illustrating the intrapelvic migration of a pin from the femur and the other a migration of the pin from the humerus through the axilla into the mediastinum. The migrating pin must move in the straight line path of its original course. The force moving the pin is either muscle or gravitational force after circumferential osteoporosis has loosened its grip on bone. The operator who has removed a Smith-Petersen nail (or any other pin, wire or nail) knows how easily it is pulled out.

REPORT OF CASES

CASE I. (From the Hospital for Joint Diseases.) *The Medial Intrapelvic Migration of a Threaded Telson Pin, Used in the Fusion of a Pagetoid Hip.* A woman, forty years old, underwent a form of hip fusion devised by Dr. David K. Telson[1] on May 29, 1944 because of continued pain in her pagetoid left hip. Telson passed a long hollow trephine drill through the neck of the femur into the ilium. The record does not state whether the core of bone taken from the drill was replaced in its channel in reversed manner. Four threaded pins passed through the joint to fix and fuse it. (Compare the method of Watson-Jones who nailed the osteoarthritic hip.)

One of the pins migrated medially into the pelvis. (The roentgenograms cannot be found.) This was discovered when she complained of "bladder irritation" in the few weeks preceding the examination of October 15, 1944. On vaginal examination the pin was easily felt as a rigid suprapubic rod with its tip just below the symphysis pubis. Laterally it could be traced to the bony pelvis. It was easily withdrawn laterally on October 16, 1944 (Dr. Burman) through a channel in the neck of the femur. So, too, were 2 other pins. Only 1 pin was left behind for its removal seemed to demand too great an opening in bone. The pin broke later and its lateral backtracking half was removed on November 17, 1947. The smaller medial part of the pin remains fixed in the head of the bone. In May, 1954, the painless hip showed neither rotation nor lateral motion, but it could be flexed to 100 degrees and extended to 160 degrees.

CASE II. *The Mediastinal Migration of a Humeral Wire.* This is a unique event, apparently never seen nor recorded before. A woman, eighty-five years old or older, fell on June 4, 1953 and dislocated her left shoulder (Fig. 1). The house surgeon used the Kocher maneuver to reduce the joint. As he adducted and internally rotated the arm, the humerus broke in its upper third along an oblique line, suggesting torsional fracture (Fig. 2).

A simple situation now became complex. The solution of the problem has been given by Winderman,[2] who advocated fixing the frac-

* From the Home and Hospital of the Daughters of Israel, New York, New York.

FIG. 1. Roentgenogram of June 4, 1953. There is a subcoracoid dislocation of the head of the left humerus and avulsion fracture of the distally displaced greater tuberosity. The humerus itself shows no fracture line.

ture site so that the bone was again a unit and then reducing the dislocation. In his case, a Kirschner wire was passed through the distal end of the proximal fragment and the wire held in a spreader. As an assistant pulled on the elbow to hold the fragments steadily, the dislocation was reduced by the Kocher method, the force of the reducing movements being applied to the spreader and thus to the bone which held the wire.

She was seen by one of us (Dr. Burman) an hour after the attempted reduction. The dislocation was unreduced. The distal humeral fragment was adducted and proximally displaced. The greater tuberosity of the humerus was broken and avulsed distally. The fragments were brought into line in abduction of 60 degrees, but the effort to reduce the dislocation by the Milch hyperabduction method failed as the fracture was manually held. The arm was then placed in traction in 20–30 degrees of abduction.

On June 7, 1953, the well reduced fracture was pinned after 10 cc. of 1 per cent procaine was injected into the hematoma. Four cc. of a 50 per cent mixture of gelatin in water was then injected into the hematoma. (The gluing of broken bones by gelatin will be reported

FIG. 2. Fracture of the humerus after attempted reduction by the Kocher maneuver, the bone breaking as the arm was adducted and internally rotated. Roentgenogram of June 4, 1953.

FIG. 3. Roentgenogram of July 6, 1953. The fracture, pinned on June 7, 1953, was now healed. The dislocation persisted.

later by Dr. Burman.) Four pins were inserted, 2 above and 2 below, each pin being approximately perpendicular to the oblique fracture line. The dislocation could not be reduced by the hyperabduction technique. It was decided to let well enough alone on the basis of past experience with unreduced dislocation of the humeral head in people of advanced age.

The pinning was firm enough to allow the arm to move as a unit and the fracture was healed solidly by July 6, 1953 (Fig. 3). The 2 upper wires backtracked and were removed without anesthesia on July 7, 1953. Postoperatively, difficulty was encountered in maintaining control of her diabetes. She left the hospital on October 11, 1953. She had no significant complaints and could lift the arm well enough to adjust her wig.

About January 22, 1954, she again complained of a little pain in the left arm. Heat to the arm was advised and a roentgenogram (Fig. 4) taken. Unfortunately this crucial roentgenogram was not seen until the actual mediastinal migration took place. On February 13, 1954, she began to expectorate a little blood. She was re-admitted to the hospital

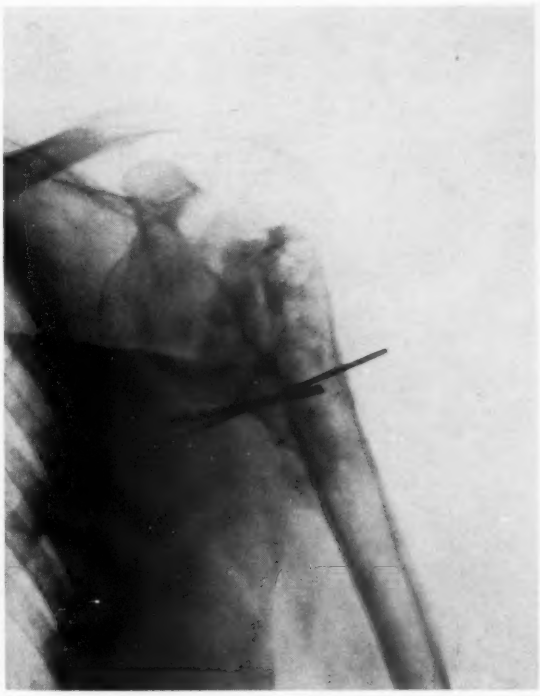


Fig. 4. Roentgenogram taken on January 22, 1954. One of the two remaining wires is migrating medially through the axilla. This crucial roentgenogram was not seen until the mediastinal migration had taken place.

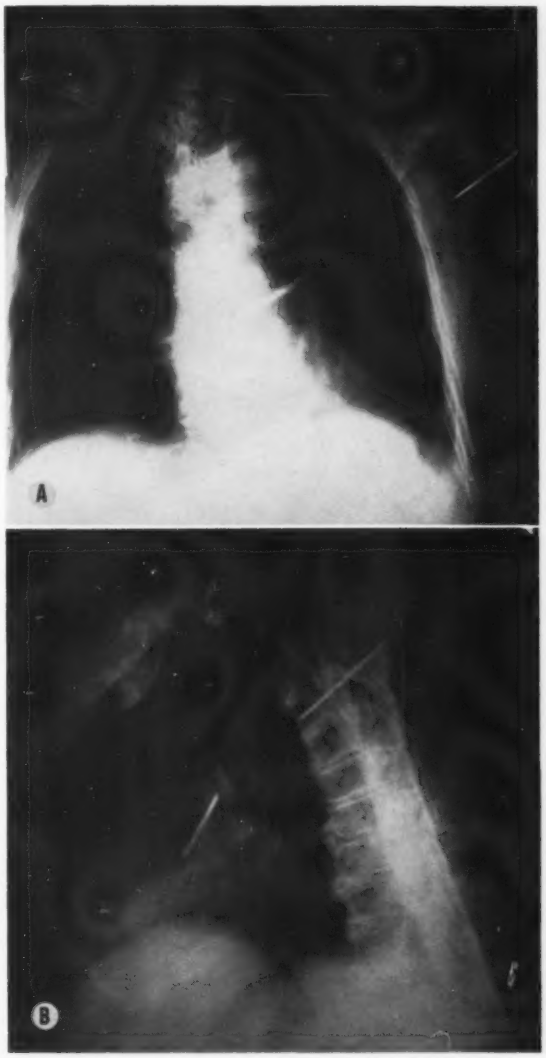


Fig. 5. (*A* and *B*) Anteroposterior and right oblique roentgenograms of the chest taken on February 19, 1954, revealing one pin in the mediastinum.

with a fever of 102.4 degrees F. The heart was enlarged to the left. The lungs showed a few rales over the bases, breath sounds being rough and vesicular. Her respirations were 22 per minute and the pulse 86. A chest roentgenogram disclosed the surprising and disturbing fact that 1 of the 2 remaining humeral wires had moved in a straight line, downward and to the right, into the mediastinum, being middle-placed with reference to the transverse and anteroposterior diameters of the chest (Fig. 5). Fluoroscopic examination indicated that the wire was well anterior to the (barium-filled) esophagus (Fig. 6). The costophrenic angles were clear and the diaphragm moved well. (It had been thought that her right upper

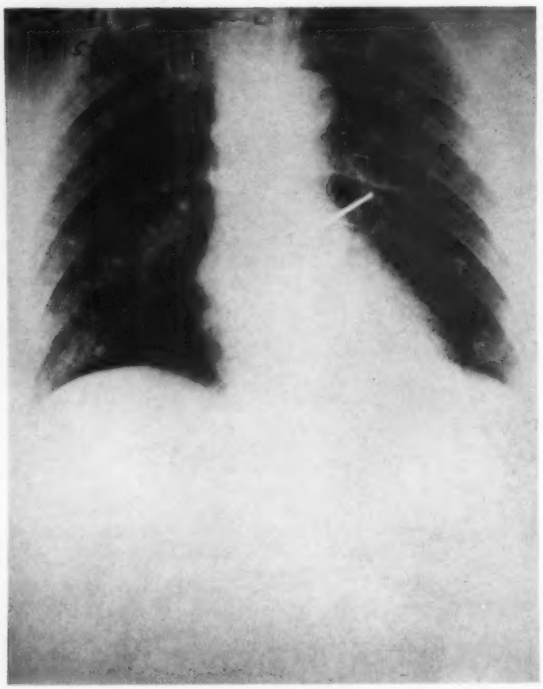


FIG. 5. (*C*) Roentgenogram of the chest taken on February 19, 1954, revealing one pin in the mediastinum.

quadrant pain was due to diaphragmatic irritation.)

The wire seemed well above the heart, but in later fluoroscopic studies as of February 25, 1954, the medial end of the wire seemed to move with the heart. Yet the stereoscopic roentgenograms of March 1, 1954 indicated that the wire lay above and posterior to the heart. It was felt that the penetration of the heart by the needle was unlikely. Dr. Rosenak attached a magnet to the skin of the right side of the chest in the posterior axillary line on March 4, 1954, but this did not move the wire. Fluoroscopic examination of April 2, 1954, showed the position of the needle unchanged. The superior edge was relatively fixed in the lung, while the inferior edge moved with the systole of the heart, seemingly touching the left border of the cardiac base. The electrocardiogram of April 9 indicated an old anterior infarct of the heart.

Bleeding from the lung remained scanty and subsided by February 18. Her fever averaged 100 degrees F. and gradually descended to normal by February 24. She was clinically well. Nonoperative treatment seemed indicated and she was given digitoxin, antibiotics and sedation as well as insulin for the control of her diabetes. In general, after the initial period of irritation, she suffered no ill effect from the mediastinal wire. The last humeral wire which had likewise begun a medial migration was removed on February 25, 1954 under local anesthesia (Fig. 7).

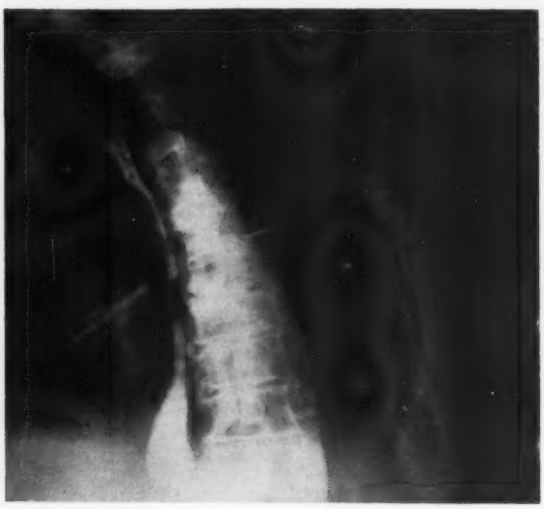


FIG. 6. Roentgenogram of February 19, 1954. The pin is anterior to the barium-filled esophagus.

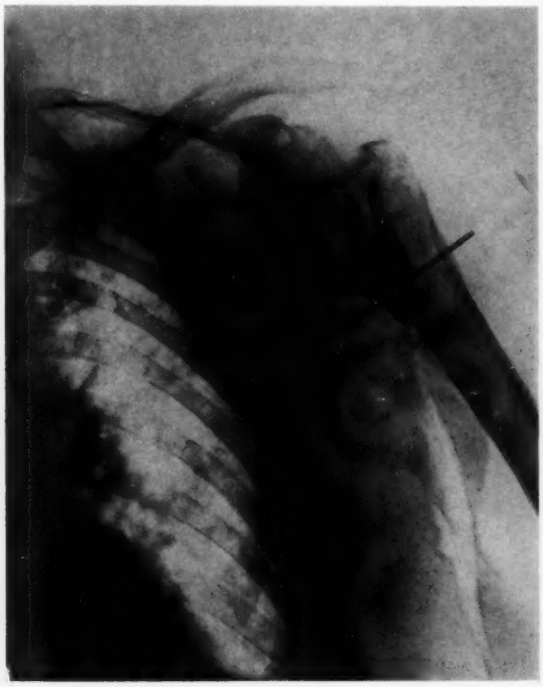


FIG. 7. The last pin likewise moved medially. (Roentgenogram of February 24, 1954.) It was removed on February 25, 1954 under local anesthesia.

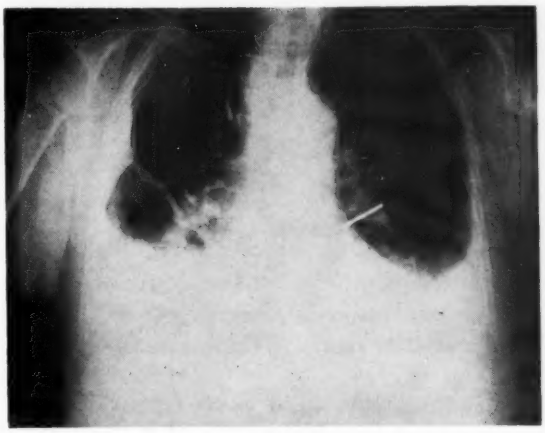


Fig. 8. Upright roentgenogram of May 20, 1954. The position of the pin was unchanged. The roentgenographic signs of congestive heart failure are obvious.

She left the hospital on May 7, 1954 but had to be re-admitted on May 27 (Fig. 8) in congestive heart failure, which caused her death on June 15, 1954 despite digitalization, the use of diuretics and the aspiration of pleural fluid. Consent for postmortem examination was not given by the family.

Michael Burman, M.D.
114 East 54th Street
New York 22, New York

ADDENDUM

Mazet (Mazet, R., Migration of a Kirschner wire from the shoulder region into lung; report of two cases. *J. Bone & Joint Surg.*, 1943, *25*, 477–483) reported 2 cases of migration of a Kirschner wire into the lung. In his first case, a man aged twenty-seven, two wires held a right acromioclavicular dislocation firmly. Seven weeks later, one of the wires left the clavicle and in another four weeks, it lodged in the right lung from which it was removed a month later. This wire had not followed the straight line course it took after it left the clavicle.

In the second case, the flail right shoulder of a girl aged sixteen was fused and three Kirschner wires passed through the humeral head into the glenoid. Four and one-half months later, two of the wires were removed and the third was found in the chest where its pointed end lay under the left second rib in the anterior axillary line. The blunt end was embedded in the right lung. The wire was removed five weeks later. The wire had taken a straight line course.

In neither case was there significant trouble—neither cough, spitting of blood, sweats, nor trouble in breathing.

REFERENCES

1. Telson, D. R. Fusion of hip joint by subcutaneous bone graft and steel pinning. *Bull. Adelphi Hosp.*, Brooklyn, N. Y., 1945, *3*, 2.
2. Winderman, A. L. Dislocation of shoulder with fracture of shaft of humerus. *Bull. Hosp. Joint Dis.*, 1940, *1*, 23–25.

UNUSUAL SEQUELA FOLLOWING PINNING OF MEDIAL CLAVICULAR FRACTURE*

By VICTOR KREMENS, M.D., M.Sc. (MED.),† *and* FRANK GLAUSER, M.D., M.Sc. (MED.), F.A.C.S., F.I.C.S.‡
PHILADELPHIA, PENNSYLVANIA

THE principle of Kirschner wire fixation of fractures involving the middle or distal third of the clavicle, either by the Murray method of internal fixation,[3] or by open operation has been well established. This method of treatment, however, is not without danger, and migration of such wires or pins into the lung, adjacent blood vessels and other tissues has been reported.[1,2,5] It is the purpose of this paper to focus attention upon the little mentioned danger of use of internal fixation for those fractures involving the medial third of the clavicle and fracture-dislocation involving the sternoclavicular joint. The use of internal metallic fixation for these fractures is particularly hazardous due to the proximity of major anatomic structures in the root of the neck and in the superior mediastinum.

Mazet,[2] in describing the results obtained in treating a patient with an acromioclavicular separation by wire fixation, stated very succinctly that " . . . unfortunately the wires instead of remaining where they were so carefully placed, migrated in various directions. Subsequently one (wire) was removed from beneath the deltoid, the other from the right lung." This same author also presented a case of Wood's in which a right shoulder flail from an old poliomyelitis was treated by fusion, with three Kirschner wires having been passed through the humeral head into the glenoid of the scapula to maintain position. Two of the wires were removed after bony fusion had occurred, but subsequent roentgen examination revealed a long segment of wire "athwart the left lung and mediastinum and penetrating the right lung." In both cases, the foreign bodies were surgically removed without incident. A similar occurrence has been reported in the European literature by Pannier and Daems[4] with discovery of an intrapulmonary Kirschner wire some time following attempted osteosynthesis of a clavicular fracture. This latter case terminated fatally as a result of postoperative complications after removal of the offending foreign body.

In the case to be presented at this time, it is of singular interest that one of two short Steinman pins inserted at open operation across fragments of a fracture in the medial portion of the left clavicle was expectorated by the patient approximately one month following such insertion. It was indeed fortunate that no complication of any type ensued despite the obvious passage of the pin from its seat within the clavicle, through the contiguous soft tissues into the tracheal lumen. The pin was delivered spontaneously following a single spasmodic spell of coughing.

REPORT OF A CASE

The patient, a fifty year old German born baker, suffered fractures of both the medial and distal extremities of the left clavicle following a fall on May 1, 1954. There was no complaint referable to the health of the patient prior to this incident. At the time of first hospital admission on May 7, the physical examination of the patient was essentially negative other than the findings pertaining to the clavicular fractures. A moderately prominent tender swelling was present over the medial aspect of the left clavicle. There was limitation of motion of the left upper extremity with pain referable to the area of the left sternoclavicular joint.

* From the Albert Einstein Medical Center, Northern Division, Philadelphia, Pennsylvania.
† Associate in Department of Radiology.
‡ Associate in Department of Oncologic Surgery.

The initial roentgen examination on May 6, 1954 revealed complete fractures involving the medial and distal portions of the left clavicle, the fractures being visualized approximately 1 inch, in each case, from the proximal and distal articulating surfaces of this bone. There was no significant disturbance in the position of fragments at the site of fracture in the distal portion of the clavicle. There was slight superior or cephalic angulation of fragments and moderate anterior or ventral angulation of fragments at the proximal fracture site (Fig. 1).

On May 10, after open reduction, the two slender Steinman pins, 4.5 cm. in length, were threaded through the medial fragments from one direction, one medially and the other obliquely.

Report of roentgen examination on May 15, 1954 was as follows. "Examination of the chest reveals two wire pins to bridge the medial clavicular fracture site. There is good position of fragments. One pin extends postero-medially and the second postero-inferiorly beyond the cortical surface of the medial portion of the clavicle. The lungs are clear. There is no evidence of an abnormal mediastinal process" (Fig. 2 and 3).

The patient was discharged from the hospital the following day without complaint, but with the left upper extremity immobilized in a position of abduction at the shoulder joint.

Four weeks later the patient was requested by the attending surgeon (F. G.) to report for roentgen examination for evaluation of healing of the clavicular fractures. At the time of the initial interview with the radiologist (V. K.) prior to the roentgen study, the patient voluntarily proffered one intact Steinman pin with the statement that the pin had been "coughed up" that morning (Fig. 6). Upon close questioning, it was determined that the patient had experienced a mild sticking sensation in the root of the neck on the left side, had twisted or

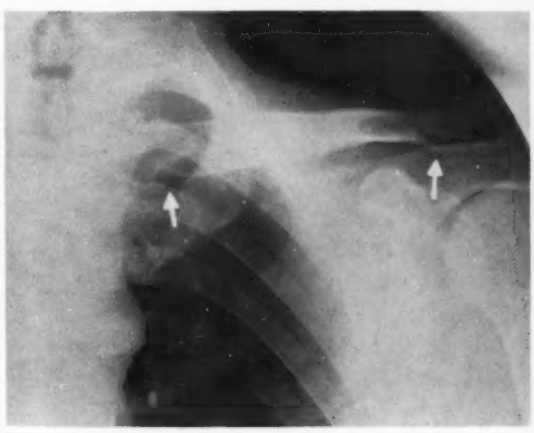


Fig. 1. Posteroanterior roentgenogram of left clavicle demonstrating fractures (arrows) in proximal and distal portions. May 6, 1954.

Fig. 2. Posteroanterior roentgenogram following insertion of two Steinman pins across medial clavicular fracture site at open operation. May 15, 1954.

Fig. 3. Lateral view on same date showing position of Steinman pins as they traversed the fracture site.

FIG. 4. Roentgen examination four weeks later reveals only one Steinman pin to be present at this time.

stretched his neck once or twice to ease this sensation and had then immediately coughed and spat the Steinman pin from his mouth. This unusual occurrence was not accompanied by any sharp pain, and there had been no further reaction.

Immediate roentgen examination revealed one remaining pin (that directed postero-inferiorly) in unchanged position as compared with the examination performed one month

FIG. 5. Lateral view at same time as Figure 4.

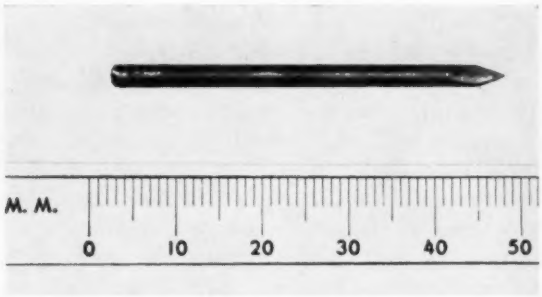


FIG. 6. Photograph of Steinman pin which was "coughed up" by patient several hours preceding examination shown in Figures 4 and 5. The remaining pin was operatively removed several days later.

previously (Fig. 4 and 5). The chest roentgenogram did not reveal any abnormality of the lungs, pleura or mediastinal structures. The clavicular fractures, incidentally, showed advanced bony healing with good position of fragments.

The patient was re-admitted to the hospital on June 23, 1954 for removal of the remaining Steinman pin and this was accomplished. Final discharge occurred on June 25, 1954 at which time the patient was completely asymptomatic.

DISCUSSION

It has been aptly stated by Mazet that there are no fixed rules governing the behavior of foreign bodies within the tissues. They may remain immobile for long periods and then migrate without apparent plan or reason. Symptoms of the presence of such foreign bodies are dependent upon the location assumed or the complication instigated.

It is most probable that the constant movement of respiratory excursion is largely responsible for the migration of pins or wires from a site within the proximal portion of the clavicle or the region of the sternoclavicular joint. Such a mechanism is less applicable in instances of internal wire or pin fixation within the middle or distal thirds of the clavicle. In the latter case, movements of the upper extremity with related motion of the shoulder girdle is most likely the mode of induction of foreign body migration. Once the metallic

device is freed of its osseous purchase, the massaging effect of muscle action may well impart a creeping mobility. Such factors as electrolysis and capillary attraction have been mentioned as possible influences upon such foreign body migration, but it is doubted that such poorly understood phenomena may be indicted in this respect in the light of our present knowledge.[2]

Lee[1] has described an operative technique of internal nail fixation for clavicular fractures utilizing a fixation device of appropriate length incorporating a flat nail head. Further development and use of such "stop" devices should be undertaken by the general and orthopedic surgeons using such fixation for fractures involving the proximal portion of the clavicle.

An additional safeguard is obviously introduced when the procedure of removal of metallic wires or pins is practiced following attainment of the desired therapeutic result.

Adequate roentgenographic examination following the procedure of internal wire or pin fixation remains, of course, one of the prime factors in the satisfactory management of such cases. Roentgen exposures in various planes should be obtained for establishment of a well-founded baseline. Interval studies during the period of maintenance of fixation must be carried out, the number of such examinations depending upon the nature and duration of such treatment. Any untoward symptomatology or reaction warrants immediate roentgen study. The advisability of roentgen examination of the involved area following removal of metallic fixation cannot be too strongly stressed. This latter caution should be followed in every case, for the protection of the surgeon as well as for the best interests of the patient. This should be accomplished despite the apparent completeness of removal of metallic parts and despite the absence of any apparent operative or postoperative complication.

SUMMARY

It is our belief that the introduction of a metallic wire or pin into the medial portion of the clavicle for fixation of fracture fragments constitutes a potentially hazardous procedure and that treatment of fractures in this area would perhaps be best handled in a different manner. Such treatment for the much more commonly occurring fractures within the middle or distal portions of the clavicle offers much less possibility of complication but should not be considered an innocuous procedure. Frequent roentgen examination before, during and after operative intervention with internal fixation remains one of the best safeguards against untoward results.

A case is presented in which one of two Steinman pins inserted into the medial portion of the clavicle was expectorated one month after insertion due to its migration from the original site into the soft tissues at the root of the neck and then into the trachea.

Victor Kremens, M.D.
Albert Einstein Medical Center
Philadelphia 41, Pennsylvania

REFERENCES

1. LEE, H. G. Treatment of fracture of clavicle by internal nail fixation; report of case. *New England J. Med.*, 1946, *234*, 222–224.
2. MAZET, R., JR. Migration of Kirschner wire from shoulder region into lung; report of 2 cases. *J. Bone & Joint Surg.*, 1943, *25*, 477–483.
3. MURRAY, G. Method of fixation for fracture of clavicle. *J. Bone & Joint Surg.*, 1940, *22*, 616–620.
4. PANNIER, R., and DAEMS, J. A propos d'un cas de corps étranger intrapulmonaire après ostéosynthèse de la clavicule. *Acta tuberc. belg.*, 1949, *40*, 360–362.
5. QUIGLEY, T. B. Management of simple fractures of clavicle in adults. *New England J. Med.*, 1950, *243*, 286–290.

LARGE FOREIGN BODY CYST WITH MIGRATION OF SMITH-PETERSEN NAIL*

By RAYMOND J. TERRAFRANCA, M.D.,† ALLAN ZELLIS, M.D.,† *and* ROMAN BABYN, M.D.‡
WASHINGTON, D.C.

THIS is a presentation of a case of an enormous multilocular foreign body cyst developing during the migration of a Smith-Petersen nail from the hip to the knee. After a careful review of the literature, we were unable to find a similar reported case. The migration of the nail took place slowly over a period of approximately three years.

There are many reports in the medical literature of the migration of foreign bodies in tissues other than those of the air and food passages without cyst formation. Cases reported with large cyst formation are relatively rare.

Rose[6] removed shrapnel from a non-inflammatory mass about the size of a plum on the left hand. The mass was a cyst which contained the shrapnel that had lodged in the left side of the patient's face five years previously and had migrated to the left hand.

Christie[2] removed a bone knitting needle from a cystic mass about the size of an orange in the left buttock of a twenty-eight year old female. Three years previously the patient had inserted the knitting needle into the vagina after missing two menstrual periods. The mass proved to be a large adventitious bursa with thickened walls. The needle had passed from the pelvis into the left buttock through the upper part of the great sacro-sciatic foramen.

Branham and Richey[1] recovered a Kirschner wire from the left side of the bladder in a sixty-four year old woman who had fractured the neck of the left femur several months previously.

Mazet[3] reports a case of a twenty-seven year old sergeant whose separated right acromioclavicular joint had been fixed by two Kirschner wires. About seven weeks later one wire was removed because it had penetrated into the shoulder. A roentgenogram taken at this time revealed the second wire to be in the posterior portion of the right upper lobe. There was no pulmonary reaction.

Mazet[3] reports a second case, one of W. S. Wood who had fused the flail right shoulder of a sixteen year old girl with old poliomyelitis. Three Kirschner wires had been introduced through the head of the humerus into the glenoid process. After four months, an assistant removed two of the wires which were protruding beyond the skin. Roentgenograms showed the third wire to be lodged in the right lung.

Mazet[3] believes that the migration in the first case that he reported may have been due to the contracting and massaging action of the muscles on the pin. Because of the paralysis and immobilization in Wood's case, muscular action could not have played any part in moving the nail.

REPORT OF A CASE

B. G., a seventy-four year old white male, was admitted to the hospital on September 3, 1952, with the diagnosis of a fracture of the middle one-third of the right femur. He had previously been admitted to the hospital on December 9, 1948, with a fracture of the neck of the right femur. At that time, the fractured neck of the femur was treated by closed reduction and Smith-Petersen nail fixation. Uncomplicated recovery and healing of the fracture occurred. After five months, the patient was able to return to his work as a carpenter.

For the next two years there was normal function of the right hip joint and the patient had no complaints. About the beginning of 1950, the patient noticed slight increase in the

* From the Gallinger Municipal Hospital, Washington, D. C.
† Department of Radiology, Gallinger Municipal Hospital.
‡ Department of Orthopedics, Gallinger Municipal Hospital.

size of his right thigh associated with some "rheumatic-like" diffuse pain. This pain was not localized and not severe enough for the patient to seek medical advice. Approximately one year later, the size of the thigh began to increase more rapidly and the pain became more frequent but still diffuse over the thigh. The swelling extended from the groin to the knee joint. The patient did not notice any swelling, discoloration, or pain below the knee. He was able to continue his work up until the day of his second admission to the hospital.

On September 3, 1952, he slipped on the floor and injured his right thigh. He was unable to use his right leg following this fall and was therefore brought to the hospital. On examination (Fig. 1, *A* and *B*), the right leg was lying in full external rotation with slight flexion of the knee. The patient was unable to lift his leg. There was evidence of two inches shortening of the involved limb. There was normal pulsation in the dorsalis pedis and posterior tibial arteries. The patient was able to freely move his toes and ankle joint but not the knee joint. There were no neurologic disturbances. The entire right thigh from the groin to the knee was grossly enlarged to twice the size of the left thigh. The skin was tense and shiny and was covered with a network of distended veins. The scar over the lateral proximal aspect of the thigh was bulging and distended. The enlargement of the thigh had the consistency of a large fluctuating cyst. There was no evidence of inflammation. The inguinal lymph nodes could not be palpated. On further examination, there was evidence of abnormal movement in the middle of the shaft of the femur. The general condition of the patient was satisfactory for his age, and the remainder of the physical examination was negative.

The first roentgen examination (Fig. 2), of the right femur, September 3, 1952, revealed a spiral fracture through the middle one-third of the shaft of the femur with moderate medial displacement of the distal fragment. There was evidence of an old healed fracture through the neck of the femur. A small translucent shadow was noted in the intertrochanteric region at the site of the bed of the Smith-Petersen nail. There was evidence of periosteal thickening

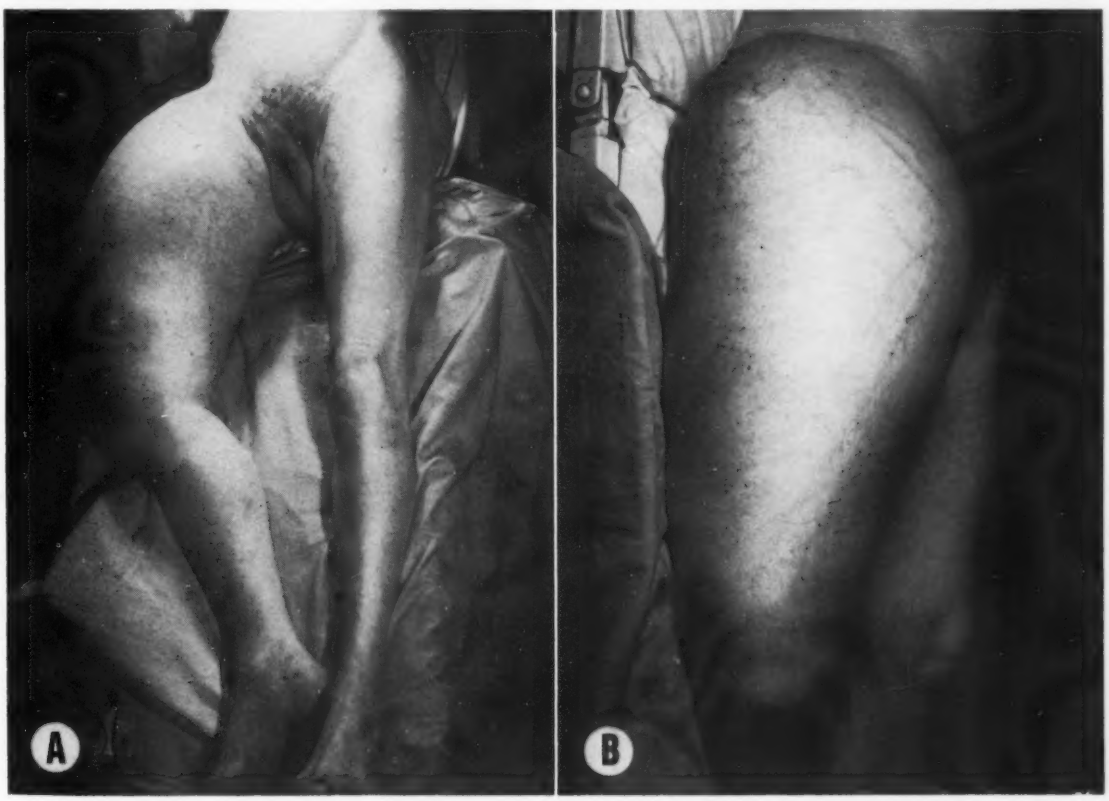


Fig. 1. (*A* and *B*) Enormous swelling extending from the groin to the knee.

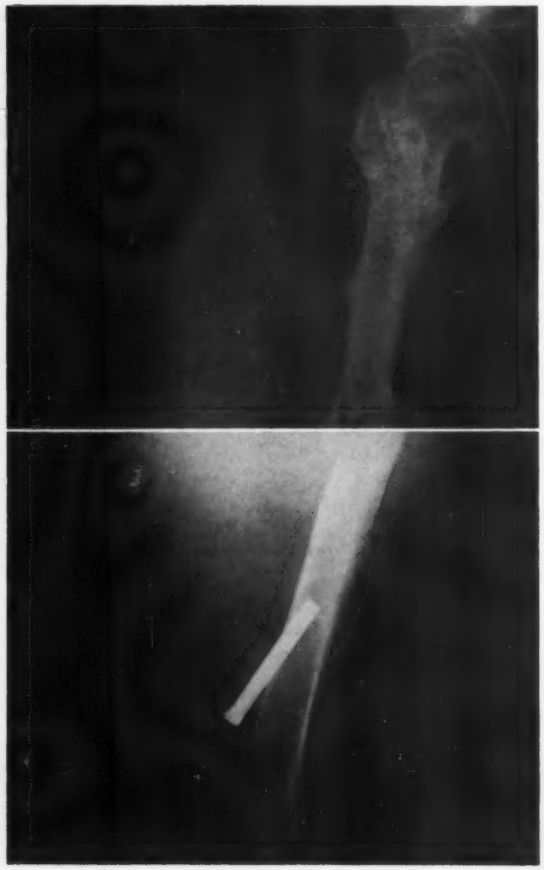


FIG. 2. Fracture through middle third of femoral shaft. Old healed fracture of neck of femur. Marked soft tissue swelling. Smith-Petersen nail in distal third of thigh.

over the lesser trochanter and over the proximal one-third of the shaft of the femur. There was marked swelling of the soft tissues of the entire thigh with obliteration of the normal tissue lines. A Smith-Petersen nail was noted in the soft tissues of the anterolateral aspect of the lower one-third of the thigh. The head of the pin was approximately 7 cm. above the upper margin of the patella.

The second roentgen examination (Fig. 3) of the right thigh, September 5, 1952, following aspiration of 100 cc. of fluid and injection of 75 cc. of diodrast showed the radiopaque material to be scattered in a large multilocular pattern from the groin to the suprapatellar area and lying mostly in the anterior and lateral portions of the thigh. These findings are consistent with a large multilocular cyst. The Smith-Petersen nail was in the lowermost portion of the cyst. The previously reported fracture was again noted. There was no evidence of bone disease.

On September 6, 1952, under local anesthesia, a slow aspiration of 10,000 cc. of fluid was performed through the lateral aspect of the distal one-third of the thigh. The fluid was mixed with blood due to the recent fracture and chemical analysis was not done. In this same area, a 2 cm. long incision was made, and the loose Smith-Petersen nail measuring 9.5 cm. in length was removed. The three-flanged stainless steel nail did not show any corrosion. Its surface was smooth and shiny and its lumen was filled with bone tissue. A biopsy of the cyst wall was obtained at the same time.

The pathologic examination (Dr. E. C. McGarry) of the aspirated fluid, after centrifuging to cell block, revealed blood clots, fibrinoid material, polymorphonuclear leukocytes and foam cells. Examination of the biopsy of the cyst wall revealed a firm pinkish tissue measuring 4×2×2 cm. with some areas of

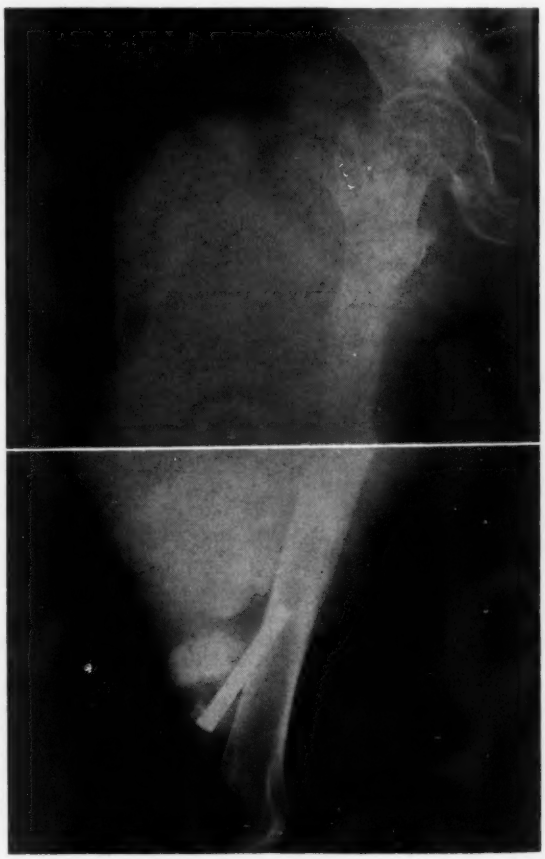


FIG. 3. Diodrast outlining large multilocular cyst, lower portion of which contains the Smith-Petersen nail.

purplish discoloration. One surface was smooth and glistening, the other granular with muscular tissue. On section the tissue was firm, purplish and homogeneous. Microscopic examination revealed collaginous, fibrous connective tissue moderately infiltrated with lymphocytes and containing numerous giant cells. These giant cells were isolated in the fibrous connective tissue and had the appearance of foreign-body giant cells. There was a moderate degree of vascularization of this wall and scattered throughout were eosinophils, plasma cells and lymphocytes. The specimen taken from the lumen of the nail had a bony consistency and was grayish-white in color. Microscopic examination showed normal bony spicules. Culture of the aspirated fluid revealed no growth.

Routine laboratory work revealed the following: Serology negative, blood calcium level 11.3 mg. per cent, inorganic phosphorus 3.4 mg. per cent, acid phosphatase 0.2 units, alkaline phosphatase 1.6 units. Total serum protein 6.8 gm. per cent (albumin 4.4, globulin 2.4). White blood cell count 9,200, red blood cell count 4,650,000, hemaglobin 90 per cent, sedimentation rate 36, hematocrit 43 per cent. Urinalysis negative.

Management of the Case. Following aspiration, a pressure dressing was applied to the right thigh from the groin to the knee joint. The leg was placed in a Thomas splint and skin traction applied (14 lbs.). On September 19, 1952, an additional 2,200 cc. of fluid was aspirated. This was similar in appearance to the previously aspirated fluid. Following the first operation, the patient was given penicillin, 600,000 units twice daily for five days, and streptomycin, one-half gram daily for three days. The patient remained afebrile.

On October 10, 1952, on the lateral aspect of the right thigh, an additional aspiration of 1,000 cc. of thick, brownish fluid was performed, and 600,000 units of penicillin and 1 gram streptomycin were injected locally. Again penicillin and streptomycin were given for four days following this third aspiration.

The traction was lessened to 8 lbs. after four weeks, and active exercise of the leg was encouraged. Roentgen examination (Fig. 4, *A* and *B*), at this time showed good callus formation. After seven weeks, the traction was discontinued and there was clinical evidence of union. Active exercise of the muscles was continued. By October 23, 1952, the patient had showed improvement in his muscle strength and could do straight-leg raising. The thigh, which appeared flabby and atrophied after the initial aspiration, was gradually returning to its normal size and shape (Fig. 5). By November 6, 1952, the muscular strength of the leg was still improving and the patient had over 90° flexion and full extension of the knee joint. On

Fig. 4. (*A* and *B*) Mid-shaft fracture healing with good callus formation. Marked decrease in size of thigh.

FIG. 5. Appearance of thigh after treatment.

November 10, 1952, the patient was allowed to use crutches without weight-bearing on his right leg.

On November 18, 1952, the last aspiration of 170 cc. of thick, brownish fluid was performed and again penicillin 300,000 units and 1 gram of streptomycin were instilled locally.

The patient was discharged from the hospital the last week of November with instructions to continue physiotherapy. In September, 1953, ten months after discharge from the hospital, re-examination of the patient showed both thighs to be of the same size and shape (Fig. 6, *A* and *B*). Function was good. There was good muscle tone and there was no limitation of motion. The patient had one inch shortening of the right leg. This was corrected by an elevated shoe.

DISCUSSION

Menegaux, Odiette, and Moÿse[4] in 1934 stated that electrolysis may produce bony resorption surrounding metallic nails and pins. Orsós,[5] in his experiments placed metals in bone and noted that an electric current passed between the metals. He observed forcible contraction of the muscles of the forearm when the radial nerve was in contact with the aluminum plate and brass screws used in the reduction of a fractured humerus.

Venable, Stuck, and Beach[7] observed that bone resorption due to electrolysis takes place when dissimilar metals are used. The plates and screws that they employed consisted of copper-nickel, aluminum-bronze, and phosphorus-bronze alloys and electroplated iron.

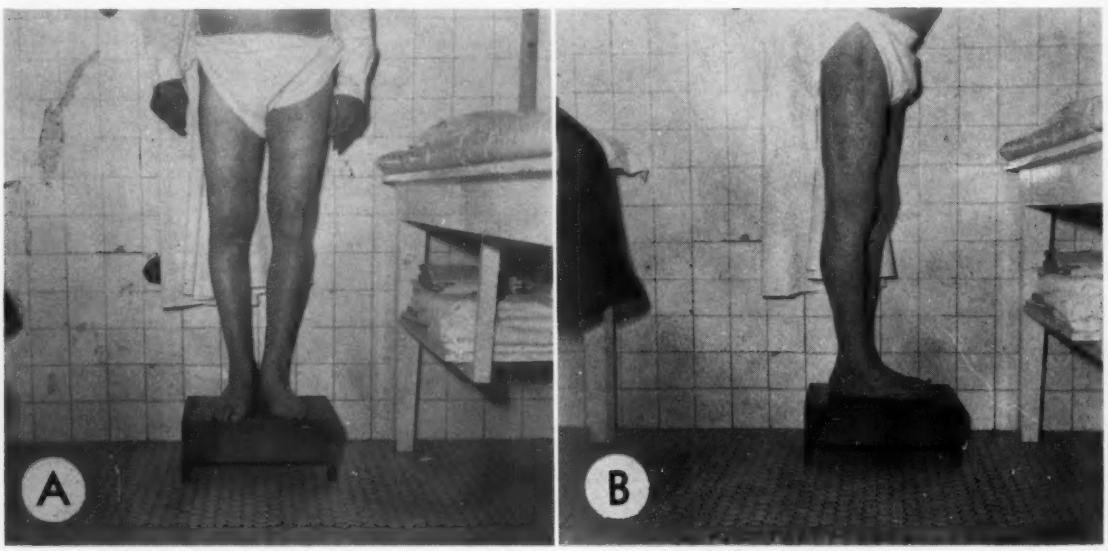


FIG. 6. (*A* and *B*) Comparison of both thighs ten months after discharge from the hospital.

Watson-Jones[8] has reviewed the subject of resorption-electrolysis extensively. He states that human fluids act as electrolytes in the presence of pairs of dissimilar metals setting up electrical batteries. The corrosion of bone in the region of screws and nails may be likened to the corrosion that occurs in the plates of any battery. Watson-Jones uses for illustration a case where a steel nail with a bronze cap over its head was used in the arthrodesis of a hip joint. A large portion of the nail dissolved and disappeared.

Electrolysis does not occur when a metal of a single element is used. However, such elements as gold, silver, lead, tantalum and titanium do not possess the strength of alloys for fixation of fractures. Alloys of elements that are far apart in the electromotive series produce electrolysis. On the other hand, alloys are inert if their elements are close together in the electromotive series since there is little potential difference between them. Vitallium is an alloy which contains inert elements and is, therefore, widely used.

CONCLUSION

The presence of a metallic foreign body in soft tissues can produce granulation or exudation or both. In reconstructing our case, the stainless steel Smith-Petersen nail became loose in its bed due to bone absorption. There was little gross evidence of electrolytic action about the nail since its surface was smooth and glistening and new bone had formed in the lumen of the nail. As the nail was being extruded, a cyst formed in the surrounding soft tissues probably due to foreign body reaction. A small cyst over the head of an inserted Smith-Petersen nail is a frequent finding when the nail is removed. At the time the Smith-Petersen nail starts to migrate through the cortex and irritates the soft tissues, the patient usually has pain and seeks medical attention. In our case, the patient, a chronic alcoholic, had pain but did not seek medication. The cyst became larger until the entire nail lodged within it. Because of the relatively large muscle mass and probably the longer delay of the pin in the upper thigh, the cyst was largest in this region. As the nail migrated toward the knee due to muscle activity, gravity, and separation of the soft tissue by the surrounding and gradually increasing fluid, smaller loculations of the cyst were formed. These loculations were clearly demonstrated roentgenologically after instillation of diodrast into the cyst.

SUMMARY

1. A case of an enormous foreign body cyst extending from the groin to the knee, secondary to migration of a Smith-Petersen nail has been reported.

2. The case came to our attention because the patient fell and fractured the shaft of the femur in the same thigh containing the cyst.

3. The new fracture healed in the usual way without complications.

4. The fluid was removed from the cyst and did not recur after removal of the Smith-Petersen nail.

5. The atrophied muscles of the involved thigh regained good function and strength.

Raymond J. Terrafranca, M.D.
8 Commodore Barney Circle, S.E.
Washington 3, D.C.

REFERENCES

1. BRANHAM, D. W., and RICHEY, H. M. Foreign body (Kirschner wire) removed from bladder. *J. Urol.*, 1947, *57*, 869.
2. CHRISTIE, G. W. Unusual tumour of gluteal region. *Brit. M. J.*, 1932, *1*, 1031.
3. MAZET, R., JR. Migration of Kirschner wire from shoulder region into lung; report of 2 cases. *J. Bone & Joint Surg.*, 1942, *25*, 477–483.
4. MENEGAUX, G., ODIETTE, D., and MOŸSE, P. Action cytotoxique de quelques métaux sur le tissu osseux cultivé "en vie ralentie"; contribution à l'étude biologique de l'ostéosynthèse. *Presse méd.*, 1934, *42*, 1844–1848.
5. ORSÓS, E. Bone sutures generating electric currents. *Zeitbl. f. Chir.*, 1925, *52*, 1014–1016.
6. ROSE, A. O. Case of encysted shrapnel. *Canad. M.A.J.*, 1927, *17*, 89–90.
7. VENABLE, C. S., STUCK, W. G., and BEACH, A. Effects on bone of presence of metals: based upon electrolysis. *Ann. Surg.*, 1937, *105*, 917.
8. WATSON-JONES, R. Fractures and Joint Injuries. Volume 1. Charles C Thomas, Springfield, Illinois, 1947.

PRIMARY EPIDERMOIDS OF THE SKULL*

INCLUDING A CASE WITH MALIGNANT CHANGE

By P. V. HAIG, M.D.
LOS ANGELES, CALIFORNIA

ABOUT 100 primary epidermoids of the skull have been described since the early part of the last century. Two of the cases published in this country developed malignancy. The third one is included in this article.

Teed's[11] compilation from the literature in 1936 lists almost half of the cases up to that time. The 9 new cases of Rand and Reeves[7] are the largest single contribution since then. The Los Angeles County Hospital has had 5 cases, of which 3 are new. Of these 3, only the one with malignant change will be described in detail. The other 2 were summarized by Rand and Reeves as Cases 3 and 5 in their series.

ETIOLOGY

The classical and widely accepted explanation, first stated by von Remak in 1854 and elaborated on by later authors, is that epidermoids arise from ectodermal rests that become sequestered during the third to fifth weeks of fetal life as the medullary groove closes. However, many epidermoids have no relation to the midsagittal line of the skull. Other mechanisms may explain the development of these. Epidermal sequestration may occur later in fetal life when the growth of bone separates the previously adherent skin and dura. Sequestration could also take place during fusion of the naso-optic groove and of the premaxillary and maxillary segments.

Origins other than sequestration are suggested by the studies of Rowbotham[8] and Gruenwald[4] which emphasize the pluripotent nature of ectoderm and the effect of "organizer influences" on it. One can easily conclude that epidermoids are caused by a local failure of "organizer influence" to convert ectoderm to mesenchyme rather than by misplacement of tissue.

PATHOLOGY

An epidermoid is a cyst with three layers in the wall: (1) An outer layer (stratum durum) consisting of collagenic fibers with a few cells, (2) a middle layer (stratum granulosum) containing epithelial cells, and (3) an inner layer, equivalent to a stratum corneum, consisting of concentric parallel fibers. The content of the cyst is putty-like and, in most cases, includes cholesterol crystals.

EVOLUTION

Age and Duration. Although epidermoids are congenital tumors, the ages at which they appear, as well as their clinical duration, are extremely variable. Caffey[1] reported a one year old child with the disease, while Givner and Wigderson[3] saw a frontal bone case in an eighty-four year old man who had had it all his life. In our group of 5 cases, the ages at which the tumors were first noted varied from four years to eighty-five years, and the durations varied from four months to sixty-three years, the shortest duration (four months) being in the patient with the latest onset (at eighty-five years of age).

Size. The size is also inconstant. The largest one in the literature is the 9 cm. parietotemporal epidermoid operated on by Cushing.[2] Our cases ranged from 1.5 to 5 cm.

Location. Primary epidermoids have been found in all of the flat bones of the calvarium, all of the paranasal sinuses, the maxilla, mandible, tympanum, and petrosa. The frontal bone, exclusive of the frontal sinus, and the various parts of the

* From the Departments of Radiology, College of Medical Evangelists, Los Angeles County Hospital, and University of Southern California School of Medicine, Los Angeles, California.

temporal bone, in the aggregate, each account for about one-fourth of all cases. The parietal bones, occipital bone, and frontal sinuses each account for about 12 to 15 per cent of cases. Other areas are involved infrequently. Three of our cases were in the frontal bone, outside the sinuses. The remaining 2 were in the frontal sinus and occipital bone.

In the paranasal sinuses and middle ear, the primary congenital epidermoids must be distinguished from epidermoids secondary to chronic infection (cholesteatomas). The lack of a history of pre-existing infection is all that can distinguish a primary from a secondary epidermoid in the paranasal sinuses. The primary tumors have a notable predilection for the frontal sinus. Of the 15 sinus cases in the literature, 11 are in the frontal sinus. The preponderance in this region may be due to more opportunities for ectodermal sequestration afforded by the closures of both the naso-optic and medullary grooves. In a case with medullary groove origin, the lesion, basically, would be a diploic ectodermal rest in the frontal bone that became trapped in the sinus during the pneumatization of the frontal bone. Figures 1*A*, 1*B* and 1*C* show three relationships to the frontal sinuses.

Fig. 1. (*A*) Frontal bone epidermoid well-separated from frontal sinuses. Male, aged seventy. Duration sixty-three years. Size 3 cm.

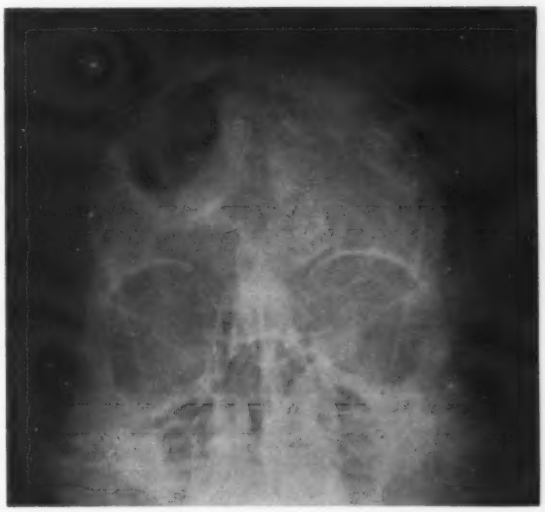


Fig. 1. (*B*) Frontal bone epidermoid encroaching on the right frontal sinus but still outside it. Female, aged forty-four. Duration thirty-six years. Size 4 cm. Unusually thick margin of sclerotic bone due to earlier unsuccessful surgery. (Previously reported as Case 5 by Rand and Reeves.)

Fig. 1. (*C*) Frontal bone epidermoid completely within the right frontal sinus, encroaching on right orbit and left frontal sinus. Female, aged eighty-five. Duration four months. Size 5 cm. Extensive sclerosis of bone on left border of tumor is unusual because there has been no previous treatment.

In the middle ear, evidence based on anatomic considerations proves the existence of primary epidermoids. Teed cited four types of cases in which congenital origin was proved on anatomic grounds, and the etiologic role of infection excluded. These were (1) epidermoids in people with complete atresia of the auditory canal, (2) epidermoids arising on the drum membrane, (3) hair-containing epidermoids (dermoids) of the middle ear, and (4) epidermoids of the petrous tip with no evidence of infection in the tympanic and mastoid parts.

History and Physical Findings. The usual history is that of a lump which has been present a long time but recently has been growing. Various neurologic symptoms may be mentioned, depending on the part of the brain subject to extrinsic pressure. Displacement of the eye is a common finding with epidermoids in or about the frontal sinuses. On palpation the mass is often fluctuant, and a defect is noted in the underlying bone.

ROENTGEN FINDINGS

The first roentgen description of a diploic epidermoid was made in 1922 by Cushing.[2] This has remained the largest lesion on record. Subsequent descriptions have varied with the size of the tumor. All cases show bone destruction delineated by a smooth margin of increased density, but the shape varies from a round defect in the small cysts to a scalloped, honeycombed defect in the large cysts. The honeycombing, as well as a sequestrum-like fragment of bone overlying the cyst, develops as the epidermoid perforates the tables of the skull. If viewed tangentially, the tables are seen to balloon. The tangential view occasionally distinguishes a pericranial tumor from a diploic epidermoid. The former erodes the skull by extrinsic pressure, so that the outer table does not balloon out.

DIAGNOSIS

The differential diagnosis includes mucocele of a sinus and a variety of cysts of obscure nature. An epidermoid is virtually indistinguishable roentgenographically from a mucocele.

Lillie and Pastore[6] described two "hemorrhagic cysts" of the frontal sinus that also could not be distinguished roentgenographically from mucocele or epidermoid. They may actually have been distinct entities, but the descriptions of the contents are suggestive of epidermoids in which the identifying epithelial lining had been destroyed by hemorrhage.

Simonton and Medwick[9] found a similar hemorrhagic cyst in the frontal bone outside the sinus.

Two peculiar acellular frontal bone cysts were reported by Handousa.[5] One had the same gross appearance as the above hemorrhagic cysts. The other contained only serous fluid. In the roentgenograms both cysts lacked the thin, sharp, sclerotic rim typical of epidermoids, but the bone was not otherwise notable. Microscopic sections of the marginal bone were called fibrocystic disease. In a true epidermoid,

FIG. 2. Sebaceous cyst of scalp indistinguishable from a frontal bone epidermoid. Male, aged thirteen. Duration since birth. Palpable mass 4 by 2 cm. One cm. defect in skull produced by extrinsic pressure. A tangential view would have excluded a diploic epidermoid but not a pericranial epidermoid.

also reported by Handousa, sections of the adjacent bone showed only simple atrophy.

On microscopic examination, epidermoids are most often mislabeled sebaceous cysts. Unfortunately, on routine skull roentgenograms, there is no way to detect the error (Fig. 2).

TREATMENT AND PROGNOSIS

The disease is cured by excision of the entire cyst wall. Recurrences will occur as long as remnants of the wall are left behind.

The 2 previously published cases with malignant change had long histories characterized by unsuccessful excisions.

Spencer's[10] case was a frontal sinus epidermoid lasting thirty-four years, under medical observation the last fourteen years, with an incomplete excision ten years prior to the cancer that ended fatally.

The case of Rand and Reeves was a parietal bone epidermoid of fifty-five years' duration. Five unsuccessful operations were done, the last being one year before death. By the fourth operation, hyperkeratotic changes in the cyst wall were noted, and at autopsy a squamous cell carcinoma was found.

A third case with cancer is presented.

REPORT OF CASE

An eighty-five year old female was admitted to the Los Angeles County Hospital in August, 1946, because of a painful tumor of four months' duration at the bridge of the nose and the left side of the forehead. The mass measured 3 by 5 cm. and felt "honeycombed with bony compartments." The overlying skin was edematous.

Roentgen examination (Fig. 1*C*) showed the changes that represent an epidermoid of the frontal sinus.

At biopsy, alternating fluctuant areas and bony ridges were noted. White fatty material oozed from one area. The tissue was found to be an epidermoid with acanthosis (Fig. 3). The findings were similar to those noted after the fourth operation in the case of Rand and Reeves.

The wound became infected after the biopsy. A complete excision was attempted in September, 1946. The cyst was external to the dura. The roof of the orbit and the posterior wall of the frontal sinus were destroyed. The posterior ethmoid cells and the nasal cavity were invaded.

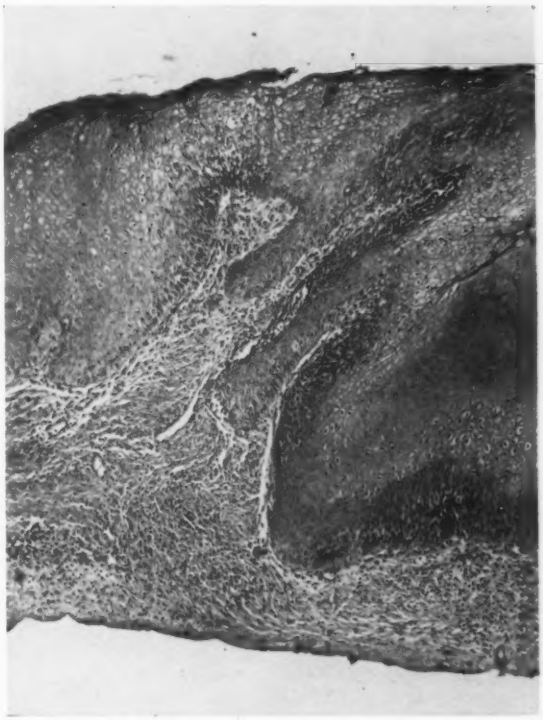


Fig. 3. Wall of epidermoid cyst showing stratified squamous epithelium with acanthosis. ×75.

Subsequently, the wound did not heal. It drained externally and into the nose. Nodular elements appeared and were biopsied in December, 1947. They contained squamous cell carcinoma Grades II–III (Fig. 4). The patient died in March, 1948.

Radiation therapy has not been considered for these cancers and is not likely to be considered soon because of their rarity. However, squamous cell carcinoma of the skin invading bones of the skull has been irradiated successfully, and there appears no reason why similar techniques could not be applied to epidermoids with cancer.

SUMMARY

Primary epidermoids of the skull are reviewed, with pertinent remarks about 5 cases at the Los Angeles County Hospital.

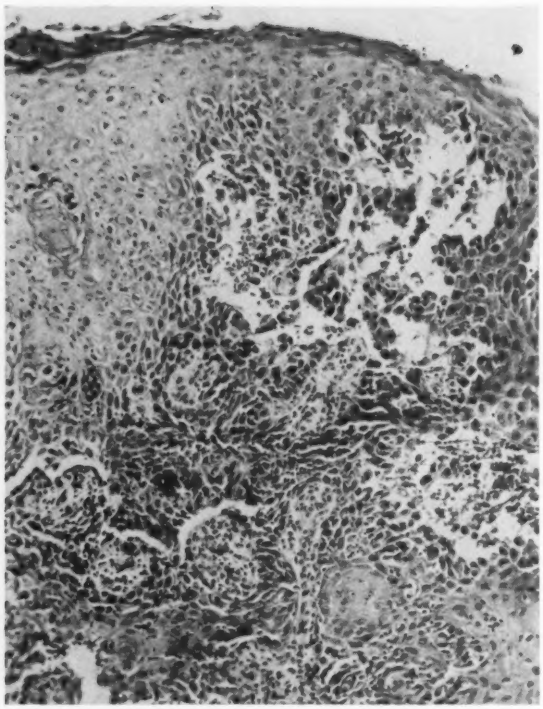


FIG. 4. Squamous cell carcinoma in epidermoid. ×125.

A case with malignant change, the third in the American literature, is presented in detail.

1200 N. State St.
Los Angeles 33, Calif.

REFERENCES

1. CAFFEY, J. Pediatric X-Ray Diagnosis. Year Book Publishers, Inc., Chicago, 1945, Pp. 77.
2. CUSHING, H. Large epidermal cholesteatoma of parietotemporal region deforming left hemisphere without cerebral symptoms. *Surg., Gynec. & Obst.*, 1922, *34*, 557–566.
3. GIVNER, I., and WIGDERSON, H. Cranial epidermoid with erosion of roof of orbit. *Arch. Ophth.*, 1948, *39*, 300–304.
4. GRUENWALD, P. Tissue anomalies of probable neural crest origin in twenty millimeter human embryo with myeloschisis. *Arch. Path.*, 1941, *31*, 489–500.
5. HANDOUSA, A. Frontal bone cysts of obscure aetiology and nature. *J. Laryng. & Otol.*, 1953, *67*, 655–668.
6. LILLIE, H. I., and PASTORE, P. N. Hemorrhagic cysts of frontal sinus which simulated mucocele; report of two cases. *Ann. Otol., Rhin. & Laryng.* 1941, *50*, 544–553.
7. RAND, C. W., and REEVES, D. L. Dermoid and epidermoid tumors (cholesteatomas) of central nervous system. *Arch. Surg.*, 1943, *46*, 350–376.
8. ROWBOTHAM, G. F. Epidermoids arising in diploe of bones of skull. *Brit. J. Surg.*, 1939, *26*, 506–514.
9. SIMONTON, K. M., and MEDWICK, J. X. Epidermoid-like lesions of frontal bone simulating mucocele; report of two cases. *Tr. Am. Laryng., Rhin. & Otol. Soc.*, 1948, *52*, 131–141.
10. SPENCER, F. R. Primary cholesteatoma of sinuses and orbit; report of case of many years duration followed by carcinoma and death. *Tr. Am. Laryng., Rhin. & Otol. Soc.*, 1930, *36*, 543–549.
11. TEED, R. W. Cholesteatoma verum tympani. *Arch. Otolaryng.*, 1936, *24*, 455–474.

Vol. 76, No. 6

EXAMINATION OF THE ATLANTO-AXIAL JOINT FOLLOWING INJURY*

WITH PARTICULAR EMPHASIS ON ROTATIONAL SUBLUXATION

By GEORGE JACOBSON, M.D.,† *and* DENIS C. ADLER, M.D.‡
LOS ANGELES, CALIFORNIA

THE atlanto-axial segment differs greatly from the remainder of the cervical spine. The atlas is a bony ring and has neither a body nor a spinous process. In the course of development, the medial part of its body becomes detached and fuses with the body of the axis to form the odontoid process. In addition, the articular masses of the atlas and the superior articular process of the axis do not correspond to the articular processes of the other cervical vertebrae, but rather to the pedicles and the lateral portions of their bodies. The articular surfaces of the atlanto-axial joint are circular and nearly flat, and the plane of the joint is almost horizontal, unlike the typical apophyseal joint which is obliquely directed.[6] Accordingly, the primary function of the atlanto-axial joint is rotation rather than flexion and extension.

As a result of these anatomic and functional differences, injury to the upper cervical spine frequently results in fractures and dislocations which differ in pattern from those encountered elsewhere in the spine. It is not our purpose in the present paper to describe in detail all the fractures and dislocations of the atlas and axis, but rather to discuss the roentgenographic examination of this region and to stress in particular rotational subluxation, an injury resulting in a disturbance of the rotatory motion of the atlanto-axial joint.

ROENTGENOGRAPHIC EXAMINATION

The atlanto-axial joint may be examined by means of (1) conventional roentgenography, (2) laminagraphy, (3) motion or functional studies.

Conventional Roentgenography. Visualization of the atlanto-axial joint is difficult in the anteroposterior projection because it is partially obscured by the maxilla and mandible anteriorly and the occiput posteriorly. However, with careful positioning, a satisfactory "open-mouth" view can usually be obtained, even in the severely injured. To avoid the necessity of re-examination, we have found it most advantageous to make two such exposures—one with the central ray perpendicular to the joint, and the other with the central ray angulated 5 degrees cephalad. In most instances one or the other projection will furnish an unobscured view of the area and permit the correct interpretation of otherwise confusing shadows (Fig. 1). These two views provide a partial substitute for stereoscopy. True stereoscopic projections of the upper cervical spine are quite difficult to obtain, particularly in the injured and, at least in our hands, have not proved necessary.

Another means of effectively eliminating the overlying mandible is the "wagging jaw" view in which the exposure is made while the patient moves his lower jaw as rapidly as possible. While the bony detail in this view is not as good as in the open-mouth view due to slight but unavoidable movement, whenever possible it should be used in addition to the latter since it also affords visualization of the third and fourth cervical vertebrae.

Two lateral views are usually employed. The first includes the entire cervical spine and is made at 72-inch tube-film distance with the tube centered in the mid cervical region. A more or less oblique projection of the atlas is obtained, frequently affording

* From the Department of Radiology of the School of Medicine, University of Southern California,† and the College of Medical Evangelists,‡ and the Los Angeles County Hospital. Presented at the Fifty-sixth Annual Meeting of the American Roentgen Ray Society, Chicago, Illinois, September 20–23, 1955.

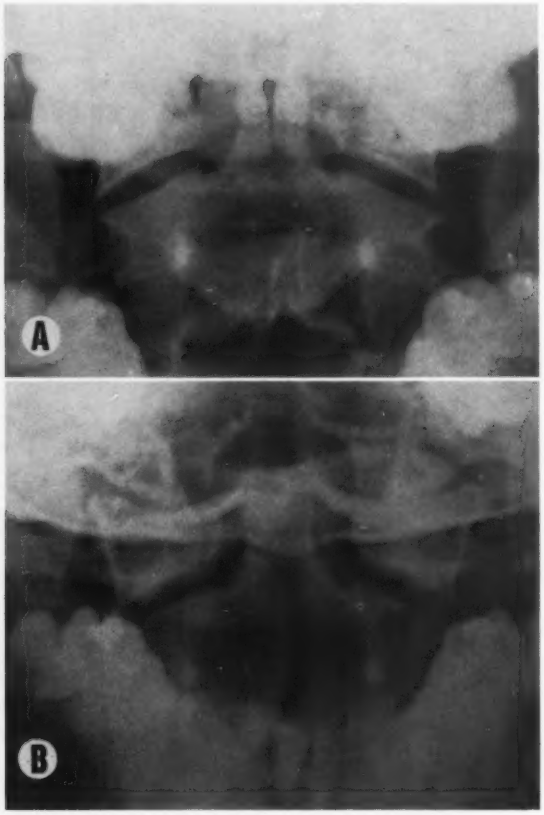


FIG. 1. Two "open mouth" roentgenograms made in slightly different projections. (*A*) Central ray perpendicular to atlanto-axial joint. The articular masses of the atlas and the odontoid are partially obscured by the upper teeth. The space between the central incisors simulates a fracture of the odontoid. (*B*) Central ray angulated 5° cephalad. The upper teeth are projected above the odontoid.

visualization of both limbs of its neural arch. The second view, at 36-inch tube-film distance, is closely coned for better detail and is centered directly over the atlanto-axial segment.

Oblique views are not used routinely but are occasionally valuable for demonstrating obscure fractures or other conditions (Fig. 2).

Laminagraphy. There are many occasions when laminagraphy may be indispensable in the examination of the atlanto-axial segment. In spite of careful positioning, it may be impossible to avoid superimposition of the teeth, mandible or occiput in the anteroposterior projection. Similarly, in the lateral projection, laminagraphy may be the only means by which the articular masses or limbs of the neural arch can be visualized separately.

In many instances, when attempting to demonstrate a fracture, laminagraphy is a much simpler procedure than repeated conventional examinations. The latter may require considerable movement of the injured neck and therefore may be quite hazardous. Laminagrams in the anteroposterior projection can be made with the patient supine and the neck immobilized. On the other hand, laminagrams are more difficult to obtain in the lateral projection. Great care must be taken to prevent movement of the head and to maintain support of the neck while the patient is placed in the lateral position. They should be made only if the anteroposterior views fail to resolve the problem.

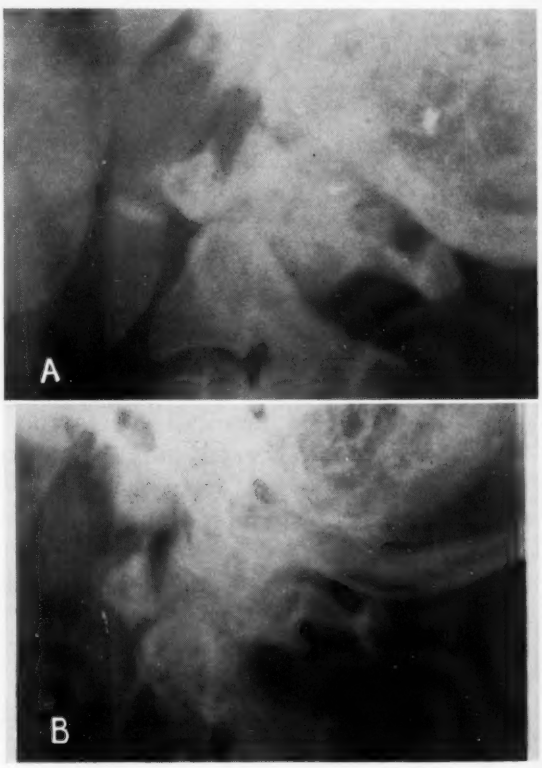


FIG. 2. Oblique views may occasionally demonstrate obscure fractures. (*A*) Increased distance between anterior arch of the atlas and the odontoid, but no other evidence of fracture. (*B*) Fracture of posterior arch of the atlas shown by slightly oblique projection.

The laminagrams made in the anteroposterior projection are most useful for the demonstration of fractures of the articular masses of the atlas and axis, the odontoid process and body of the axis. Those made in the lateral projection are most useful in the demonstration of fractures of the pedicles and neural arches.

The various lateral displacements of the atlas on the axis (offset*) have been shown by us in a previous study[9] to be associated in the majority of instances (64.5 per cent) with fractures and/or dislocations of the atlas and axis. Neither lateral offset of one articular mass of the atlas, nor bilateral spread of the articular masses can occur without a break in the ring of the atlas. Occasionally the fracture cannot be visualized in the conventional views but may be readily demonstrable by laminagraphy (Fig. 3). It should be noted, however, that we have encountered several instances of unilateral offset and bilateral spread in children, in which fractures could not be demonstrated even by laminagraphy. In these cases it is assumed that the fracture has occurred in the cartilaginous portion of the ring.

Motion or Functional Studies. Injury to the atlanto-axial joint need not result in fracture but may produce subluxations which cannot be diagnosed by the usual static roentgenographic examination.

Normally, there is only slight anteroposterior movement of the atlas on the axis. Jackson[8] and de Seze, Dijian, and Martin[11] have each reported cases of increased mobility in this plane following trauma. They demonstrated an increase in the distance between the anterior arch of the atlas and the odontoid on roentgenograms taken in the lateral projection during hyperextension and hyperflexion. It may be that we have not seen examples of this type of injury because we have not used flexion and extension views for this purpose. Perhaps this should be investigated further.

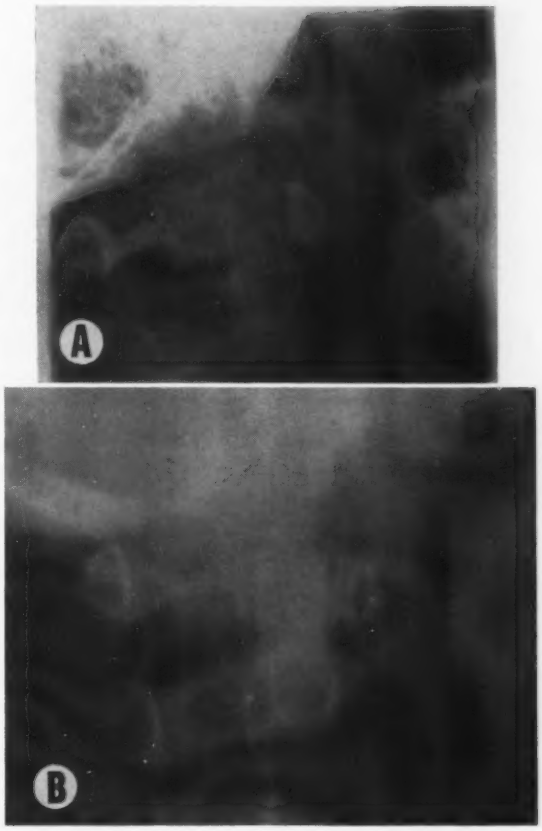


Fig. 3. Laminagraphy may be the only method of demonstrating fracture. (*A*) Lateral view shows slight separation of the odontoid and anterior arch of the atlas. A unilateral lateral offset was present in the anteroposterior view but no actual fracture could be seen. (*B*) Laminagram. Fracture of the posterior arch of the atlas.

Slight lateral movement of the atlas on the axis can be produced by abduction of the head.[5,9,10] To our knowledge no cases of abnormal mobility in this plane have been reported and we have not personally encountered any.

Rotation of the atlas about the odontoid is the principal movement of the atlanto-axial joint. We have studied rotation in

* *Offset* may be defined as overriding of the articular masses of the atlas and axis as seen in the anteroposterior projection. The following types of offset may be encountered:

(1) *Unilateral medial offset:* Medial displacement of one articular mass of the atlas with respect to the corresponding articular mass of the axis without apparent disturbance of the relationship of those of the opposite side.

(2) *Unilateral lateral offset:* Lateral displacement of one articular mass of the atlas with respect to the corresponding articular mass of the axis without apparent disturbance of the relationship of those of the opposite side.

(3) *Bilateral offset:* Unidirectional lateral displacement of both articular masses of the atlas on the axis.

(4) *Bilateral spread:* Displacement of the articular masses of the atlas in opposite directions.

normal individuals and have found that the relationship of the articular masses of the atlas and axis as seen in the anteroposterior projection can be used with considerable accuracy to evaluate the degree of rotation.[10] We have employed the following technique: Three sets of laminagrams are made, one with the head in the sagittal plane, and one each with the head rotated symmetrically approximately 45 degrees to the right and to the left. This position can be attained with sufficient accuracy by aligning the external canthus of the eye with the larynx. With the head thus rotated, the articular masses can be visualized occasionally through the open mouth by conventional roentgenography. In most instances, however, this is impossible because of obscuring bony structures. Laminagraphy eliminates this difficulty. The patient lies supine on the table. During the procedure, care must be taken that the shoulders do not rotate with the head. Laminagrams are made from the 8 to 12 cm. levels, as measured from the table top, for the average adult patient. In follow-up examinations one or two sections made at predetermined optimum levels are usually sufficient. Wagging of the jaw while the exposures are being made improves the quality of the laminagrams. Buetti[2,3] has found a similar functional examination to be of great value. His technique differs from ours in that he has not employed laminagraphy. De Seze, Dijian, and Martin[11] have also mentioned analysis of the movements of the atlanto-axial joint by serial exposures taken through the open mouth and fluoroscopy, without giving the details of their examination.

ROTATIONAL SUBLUXATION

While studying the significance of lateral atlanto-axial displacements following injury, we encountered several instances of persistent unilateral medial offset in which no fracture could be demonstrated.[9] At that time we were aware that Paul and Moir,[10] and Dankmeijer and Rethmeier[7] believed that this type of displacement occurred normally. However, we found that it was necessary to rotate the head to reproduce it. A review of our cases in which unilateral medial displacement was present showed that in none was the head significantly rotated from the sagittal plane. In addition, each of the patients had symptoms referable to the cervical spine. We then became suspicious that these cases might represent a form of injury with which we were not familiar. It also became apparent that to understand this type of offset we would have to have a clear concept of the roentgen appearance of the joint during its various stages of rotation.

ROTATION OF THE NORMAL ATLANTO-AXIAL JOINT

Turning of the head is accomplished chiefly in the atlanto-axial joint. This is not a simple uniform rotation of the atlas

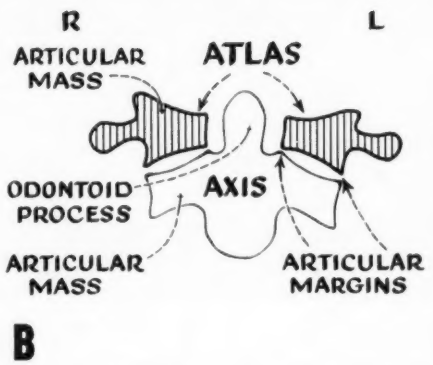


FIG. 4. *Neutral position.* (*A*) The margins of the articular masses of the atlas and axis are aligned. (*B*) Outline drawing, anteroposterior view, of atlanto-axial joint with the head in the sagittal plane.

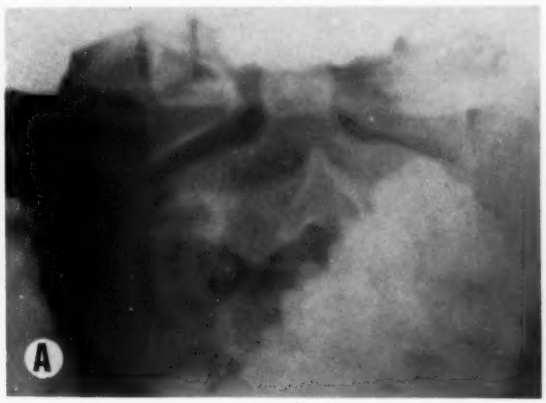
about the odontoid process but occurs rather as a complex motion.

With the head in the neutral position, an anteroposterior roentgenogram shows the corresponding articular masses of the atlas and axis symmetrically placed and the margins of their articular surfaces aligned (Fig. 4).

As the head is turned to the right, the contralateral (left) articular mass of the atlas at first slides directly forward while the ipsilateral (right) articular mass rotates posteromedially. In the anteroposterior roentgenogram, the left articular mass remains aligned while the right articular mass appears to be displaced medially (Fig. 5).

As rotation of the head proceeds the contralateral articular mass of the atlas continues to move anteriorly but, in addition, now rotates medially. The ipsilateral articular mass continues to rotate posteromedially. *The anteromedial movement of the contralateral articular mass is rarely as great as the posteromedial movement of the ipsilateral articular mass.* At this stage of rotation the anteroposterior roentgenogram shows rathers marked medial displacement of the ipsilateral articular mass of the atlas and slight medial displacement of the contralateral mass (Fig. 6).

As the head rotates to its maximum degree, the articular masses now pivot about the odontoid process, one anteromedially and the other posteromedially so that they may be completely separated from the corresponding articular masses of the axis. This physiologic dislocation of the articular masses of the atlas from those of the axis is shown best in the conventional prone lateral view of the skull (Fig. 7).



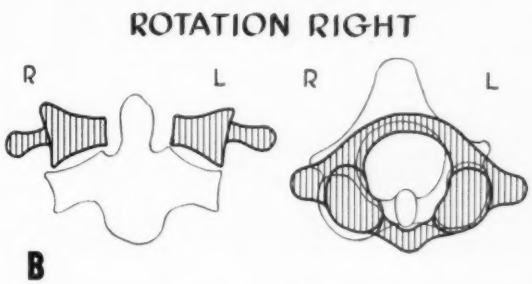


Fig. 5. *Normal motion—slight rotation to the right.* (*A*) Slight medial offset of the right (ipsilateral) articular mass of the atlas. No offset of left (contralateral) articular mass. (*B*) Outline drawing, anteroposterior and top views. The ipsilateral articular mass rotates posteromedially, producing the offset. The contralateral mass slides directly forward.

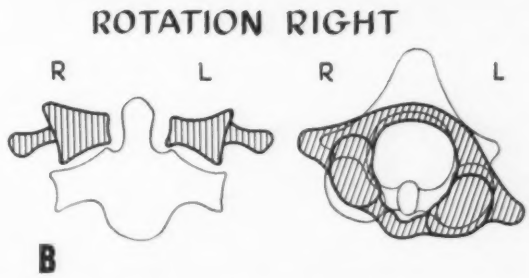


Fig. 6. *Normal motion—moderate rotation to the right.* (*A*) Laminagram. Moderate medial offset of the right (ipsilateral) articular mass and minimal offset of the left (contralateral) articular mass. (*B*) Outline drawing, anteroposterior and top views. The ipsilateral articular mass continues to rotate posteromedially, increasing the medial offset. The contralateral mass begins to rotate medially as well as anteriorly, producing a slight medial offset.

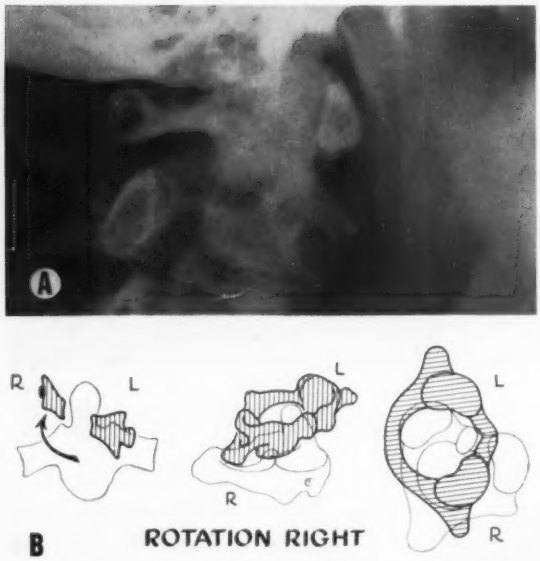


FIG. 7. *Normal motion—maximum rotation to the right.* (*A*) Both articular masses of the atlas are superimposed and are no longer in contact with those of the axis. (*B*) Outline drawing, anteroposterior, oblique and top views. The atlas pivots about the odontoid so that the articular masses of the atlas and axis are completely separated.

Variations have been encountered but they have been mainly in degree of offset and have not altered our basic concept of the mechanism of rotation and its roentgenographic appearance.

REPORT OF CASES

CASE 1. E. C., a fifty-two year old female, was admitted to the hospital on June 5, 1954. She had fallen down a flight of stairs approximately two hours before entry and had been unconscious for about fifteen minutes. She complained of slight headache. On admission she had no complaints referable to the neck. The physical examination was normal except for a small laceration of the right palm.

On June 6, 1954, she complained of pain in the lower neck, and at this time limitation of motion, particularly of rotation of the head, was present.

June 8, 1954. *Roentgenographic examination of the cervical spine* showed a 3 mm. medial offset of the right articular mass of the atlas on the axis (Fig. 8*A*). No fracture or other significant abnormality was demonstrated.

June 10, 1954. *Motion study of the atlanto-axial joint. Neutral position:* Right medial offset still present. *Rotation of the head to the right* (Fig. 8*B*) produced a slight increase in the medial offset of the right articular mass of C 1 without displacement of the left articular mass. *Rotation of the head to the left* (Fig. 8*C*) caused the medial offset of the right articular mass of C 1 to disappear without producing an appreciable offset of the left articular mass of C 1.

June 15, 1954. The patient was now asymptomatic and there was no longer any limitation of motion of the head.

Motion study of the atlanto-axial joint. Neutral position (Fig. 9*A*). The unilateral medial offset

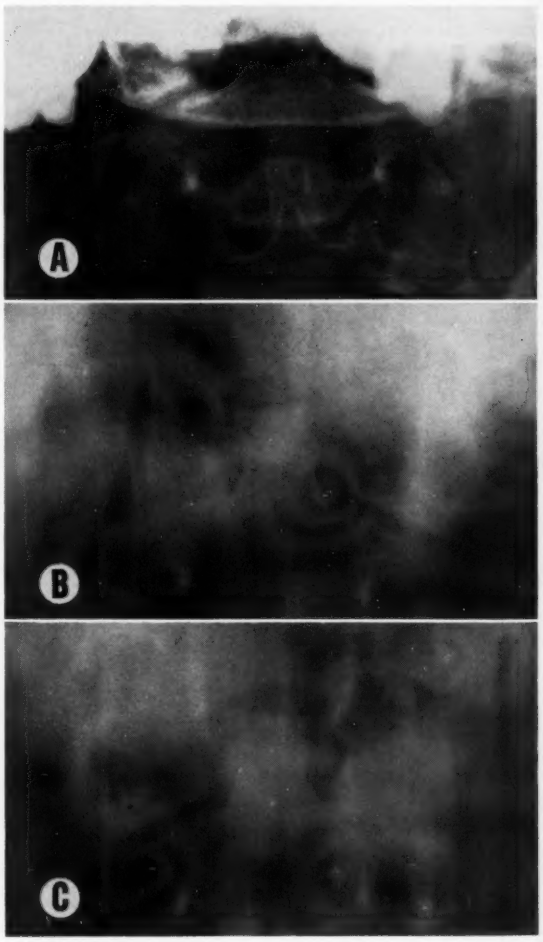


FIG. 8. Case 1. (*A*) June 8, 1954. Medial offset, 3 mm., of the right articular mass of atlas. June 10, 1954. Right medial offset still present. *Motion study.* (*B*) *Rotation to the right:* Slight increase in the medial offset of right articular mass of the atlas. No offset on the left. (*C*) *Rotation to the left:* The right medial offset has disappeared and no offset has been produced on the left.

was no longer present. *Rotation of the head to the right* (Fig. 9*B*) produced a moderate medial displacement of the right articular mass of C 1 and minimal medial displacement of the left articular mass. *Rotation of the head to the left* (Fig. 9*C*) produced offsets of the articular masses comparable to those seen with rotation to the right, namely, moderate offset of the ipsilateral articular mass and minimal offset of the contralateral mass.

Comment. Several days after injury, while the patient was still symptomatic, the right unilateral medial offset demonstrated at the first examination was still present. A motion study of the atlanto-axial joint at this time showed (1) rotation to the right produced only slight increase in offset of the ipsilateral articular mass of the atlas, and (2) rotation to the left failed to produce the expected offset of the left articular mass, while the offset of the contralateral mass disappeared.

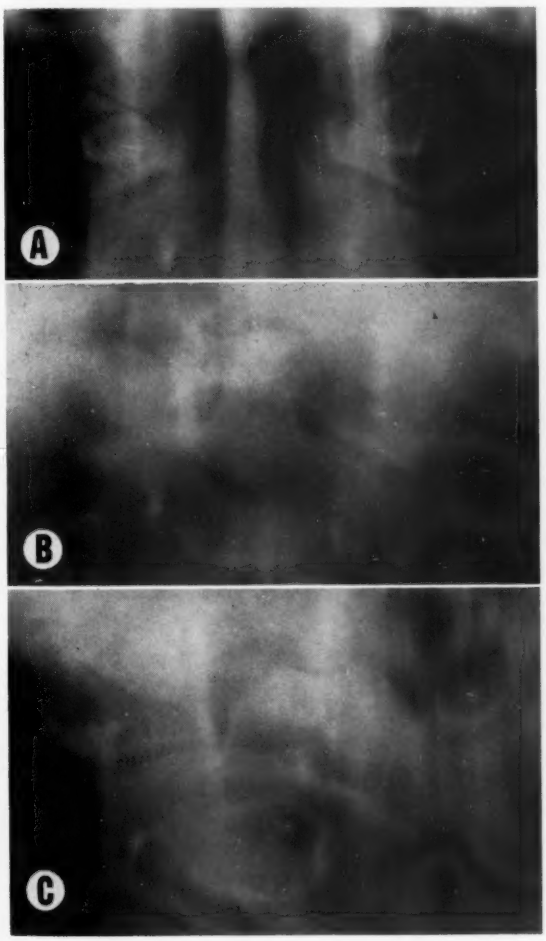


Fig. 9. Case 1. June 15, 1954. Patient asymptomatic. *Motion study.* (*A*) *Neutral position:* Right medial offset no longer present. (*B*) *Rotation to the right:* Moderate medial offset of right articular mass and minimal medial offset of left articular mass of the atlas. (*C*) *Rotation to the left:* Moderate medial offset of left articular mass and minimal medial offset of right articular mass of the atlas.

The patient became asymptomatic several days later and the motion study was repeated. The offset was no longer present and the type and range of motion of the atlanto-axial joint had returned to normal.

Case II. D. S., a seventeen year old female, was admitted to the hospital on July 27, 1954. Shortly before entry the patient was riding in an automobile which stopped quickly and she was thrown forward, striking the back of her head on the dashboard. She was in a hysterical state but stated that she had not lost consciousness at any time. On physical examination the right side of her neck was slightly tender and there was a contusion of the scalp. No other positive findings were noted.

Roentgenographic examination of the cervical spine showed a 2 mm. medial offset of the left articular mass of C 1. The spine was otherwise normal.

July 30, 1954. *Motion study of the atlanto-axial joint. Neutral position* (Fig. 10*A*): The medial offset of the left articular mass of C 1 was unchanged from the previous examination. *Rotation of the head to the right and to the left* (Fig. 10, *B* and *C*) demonstrated very little motion in the joint and there was almost no change in the medial offset of the left articular mass in either position.

August 3, 1954. The patient was asymptomatic and was discharged from the hospital.

Rotation study of the atlanto-axial joint. Neutral position (Fig. 11*A*). The medial offset of the left articular mass of C 1 was no longer present. *Rotation of the head to the right* (Fig. 11*B*) produced a considerable medial offset of the right articular mass of C 1 and slight medial displacement of the left mass. (Note the rather marked degree of rotation of the head.) *Rotation of the head to the left* (Fig. 11*C*) produced slight medial offset of the left articular mass of C 1 with no displacement of the right articular mass. (Note that there is less rotation of the head than above.)

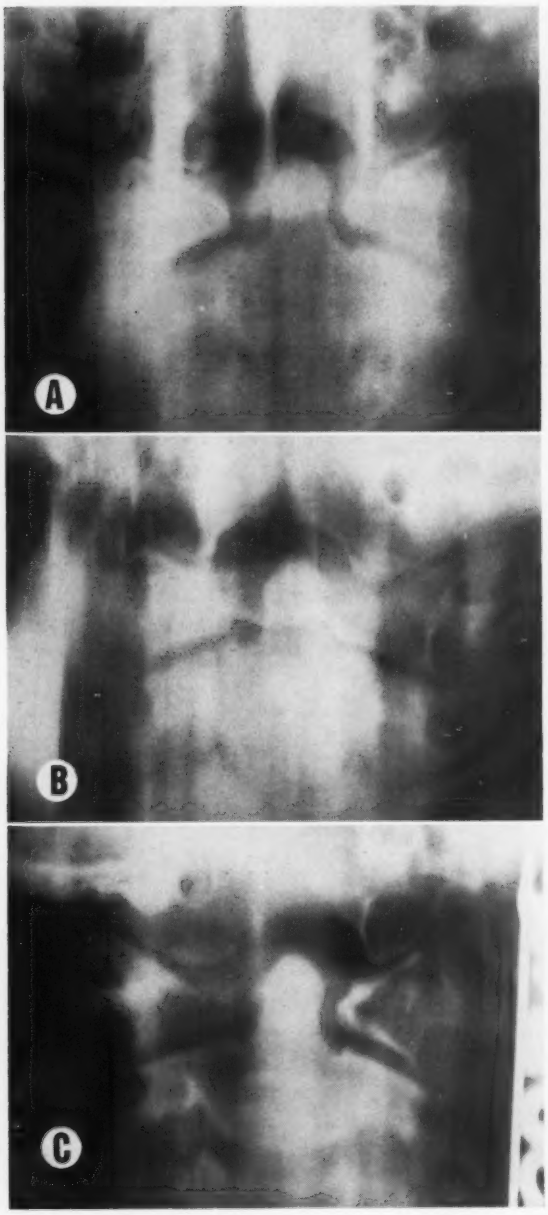


FIG. 10. Case II. July 30, 1954. *Motion study.* (*A*) *Neutral position:* Medial offset, 2 mm., of left articular mass of atlas unchanged from original examination of July 27, 1954. (*B*) *Rotation to the right:* No change in relationship of articular masses of the atlas and axis. (*C*) *Rotation to the left:* Relationship of articular masses unchanged.

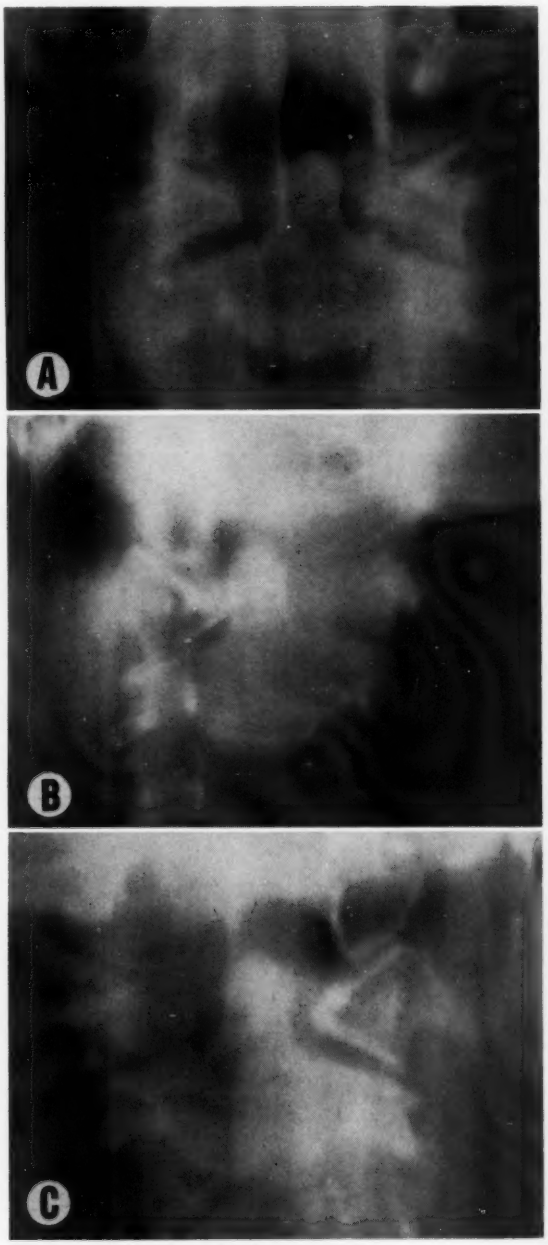


FIG. 11. Case II. August 3, 1954. Patient asymptomatic. *Motion study.* (*A*) *Neutral position:* Medial offset of left articular mass of atlas no longer present. (*B*) *Rotation to the right:* Moderate medial offset of right articular mass of the atlas. Slight medial offset of the left. (*C*) *Rotation to the left:* Slight medial offset of left articular mass of atlas. No offset of the right. (Rotation of head less than in *B*.)

Comment. Following an injury in which there were minimal physical findings referable to the neck, a left unilateral medial offset was demonstrated. Three days later a motion study of the atlanto-axial joint showed a persistence of the offset. The articular masses failed to change their relationship with rotation of the head.

Seven days after injury the patient became asymptomatic; the offset disappeared,

and the motion of the atlanto-axial joint returned to normal.

Case III. C. M., a twenty-eight year old white female, was admitted to the hospital on October 30, 1954. Several hours before entry, she attempted suicide by throwing herself in front of her husband's automobile. Physical examination revealed multiple abrasions of the back, hips, legs, face, etc. There was moderate tenderness in the upper cervical region and she complained of pain in the back of the neck on rotation of the head. Her reflexes were normal.

October 30, 1954. *Roentgenographic examination of the cervical spine* showed a 2 mm. medial offset of the left articular mass of C 1. The spine was otherwise normal.

November 2, 1954. *Motion study of the atlanto-axial joint. Neutral position* (Fig. 12*A*): The medial offset of the left articular mass of C 1 was unchanged from the previous examination. *Rotation of the head to the right* (Fig. 12*B*) produced no appreciable change in the relationship of the atlas and axis as compared to the neutral position. *Rotation of the head to the left* (Fig. 12*C*) caused a slight increase in the medial offset of the left articular mass of C 1 while producing no change in the alignment of the right articular mass.

November 18, 1954. The patient still had tenderness in the neck and limitation of motion. *Motion study of the atlanto-axial joint* showed no change from the previous study of November 2, 1954.

January 19, 1955. She continued to complain of limitation of motion and still had slight upper cervical tenderness. *Motion study of the atlanto-axial joint* (Fig. 13, *A*, *B* and *C*) showed that the realtionship of the articular masses of the atlas and axis had not changed from the first examination.

Comment. Following an injury in which there were moderate symptoms and physical findings referable to the upper neck, a left unilateral medial offset of the atlas was demonstrated. Two days later it was still present and a motion study showed (1) rotation to the left caused only a slight increase in the medial offset, and (2) rotation to the right produced no change in the relationship of the atlas and axis and failed to show medial offset of the right articular mass.

After an interval of two and one-half months, during which two motion studies were done, both the unilateral medial offset and the marked restriction of motion of the atlanto-axial joint persisted. Symptoms and positive physical findings were still present though there had been some improvement.

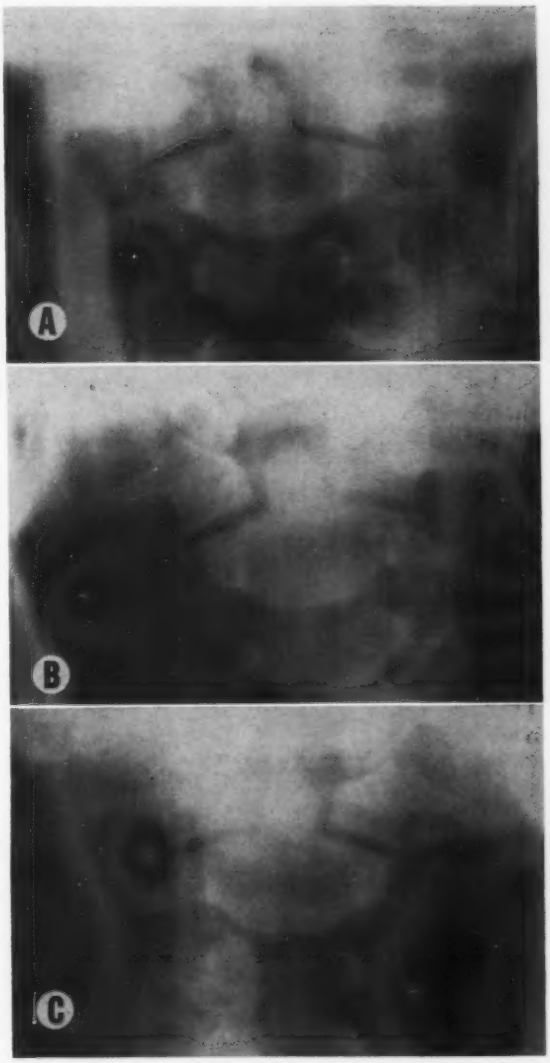


Fig. 12. Case III. November 2, 1954. *Motion study.* (*A*) *Neutral position:* Medial offset, 2 mm., of left articular mass of atlas unchanged from original examination of October 30, 1954. (*B*) *Rotation to the right:* Relationship of articular masses unchanged. (*C*) *Rotation to the left:* Slight increase in the offset of the left articular mass. No change on the right.

Case IV. G. J. L., a thirty-five year old white male, was admitted to the hospital on February 24, 1955. Eight hours prior to entry

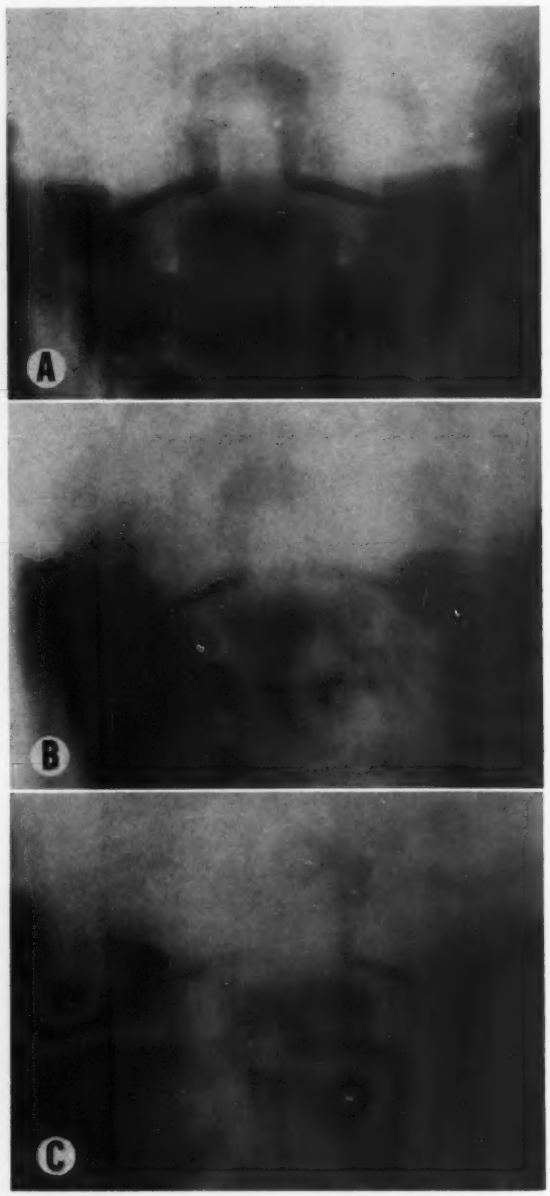


FIG. 13. Case III. January 19, 1955. Patient still symptomatic. *Motion study.* (*A*) *Neutral position:* Medial offset of left articular mass of atlas still present. (*B*) *Rotation to the right:* No change in the relation of articular masses. (*C*) *Rotation to the left:* Slight increase in offset of left articular mass unchanged from original motion study (Fig. 12*C*).

his automobile was struck rather violently in the rear. He did not lose consciousness. He complained of pain in the neck and shoulder, some difficulty in moving all of his extremities, and loss of sensation in his legs.

Physical examination revealed considerable tenderness in the lower cervical region and much pain with the slightest motion of the head or neck. He had difficulty in moving either his arms or legs. Vibratory and position sense were normal. There was marked diminution of the sensation of pain below C 1. The reflexes below the neck were diminished to absent. Spinal fluid: Pressure, 160 mm. Hg; Queckenstedt test normal; microscopic study normal.

February 24, 1955. *Roentgenographic examination of the cervical spine.* There was a 3.5 mm. medial offset of the left articular mass of C 1. The spine was otherwise normal. *Motion study of the atlanto-axial joint. Neutral position* (Fig. 14*A*): The medial offset of the left articular mass of C 1 was still present. *Rotation of the head to the right* (Fig. 14*B*) caused an increase in the medial offset of the left articular mass of C 1 while the alignment of the right articular mass was maintained. *Rotation of the head to the left* (Fig. 14*C*) did not change the medial offset of the left articular mass of C 1 but did cause a medial offset of the right articular mass.

February 28, 1955. The neurologic changes were no longer present. The patient still complained of a stiff neck.

March 17, 1955. The patient still complained of moderate pain in the neck and shoulder. He had no reflex or sensory changes.

March 28, 1955. His complaints and physical findings were unchanged. *Motion study of the atlanto-axial joint. Neutral position:* The medial offset of the left articular mass of C 1 was unchanged. *Rotation of the head to the right and left* showed no significant change from the previous study.

April 7, 1955. The patient stated that he still had pain in the neck and both shoulders, particularly the right. He had been wearing a Schontz neck collar since his discharge from the hospital five weeks previously.

May 9, 1955. His complaints were unchanged and there was some limitation of motion of the neck, including rotation, flexion and extension. An electromyograph was normal. *Motion study of the atlanto-axial joint. Neutral position* (Fig. 15*A*): Only slight medial offset of the left articular mass of C 1 remained. *Rotation of the head to the right* (Fig. 15*B*) caused an increase in the medial offset of the left articular mass. *Rotation of the head to the left* (Fig. 15*C*) produced very slight increase in the medial

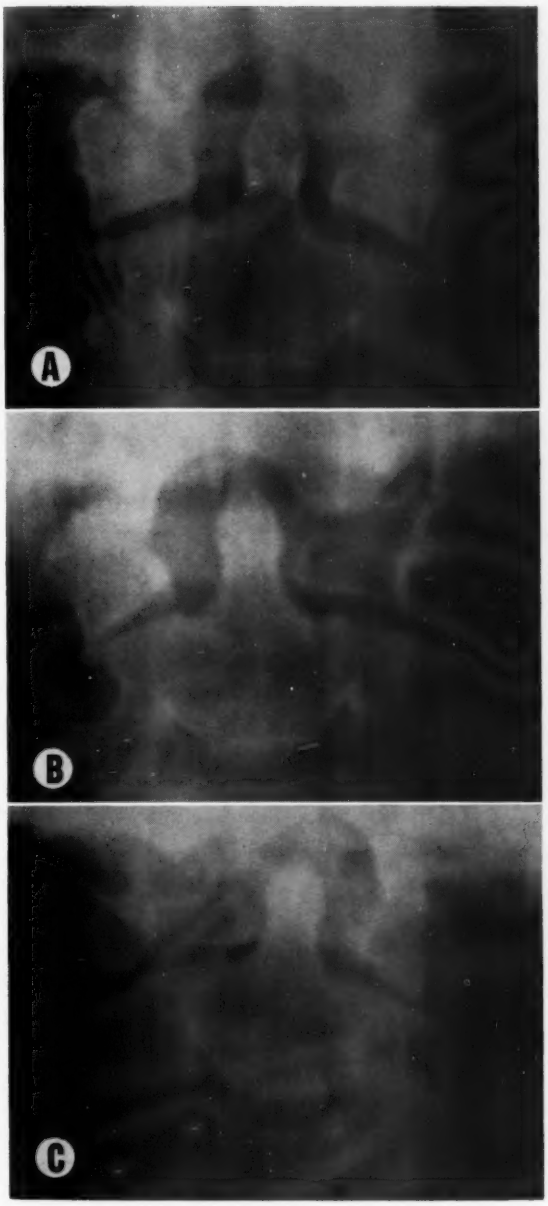


Fig. 14. Case iv. February 24, 1955. *Motion study.* (*A*) *Neutral position:* Medial offset, 3.5 mm., of left articular mass of the atlas unchanged from "open-mouth" view of same date. (*B*) *Rotation to the right:* Increase in the medial offset of the left articular mass. No offset on the right. (*C*) *Rotation to the left:* No change in the medial offset of the left articular mass. Slight medial offset of the right articular mass.

offset of left articular mass and moderate medial offset of the right articular mass.

June 23, 1955. The patient still complained of pain and limitation of motion, particularly

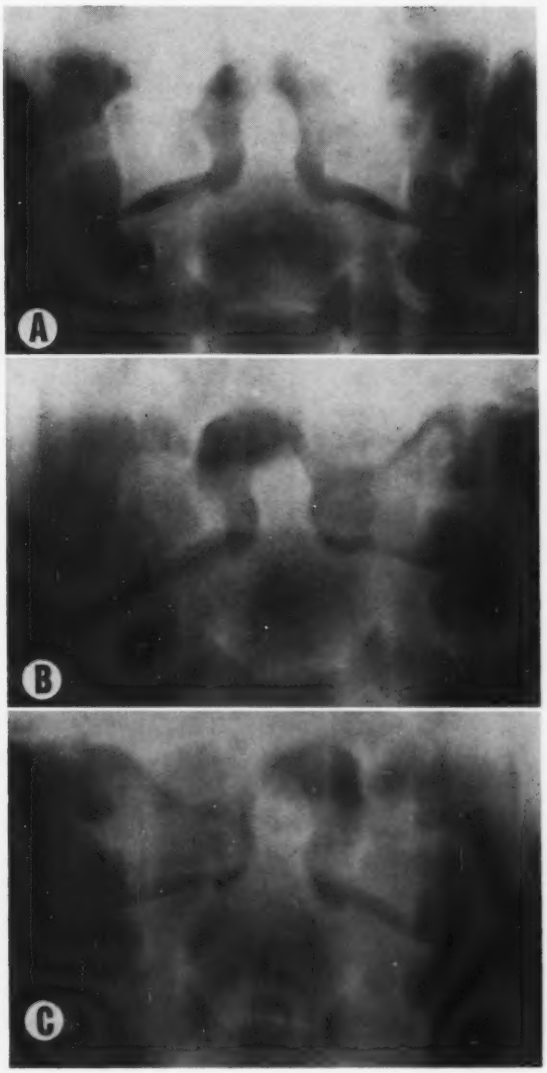


Fig. 15. Case iv. May 9, 1955. Patient still symptomatic. *Motion study.* (*A*) *Neutral position:* The medial offset of the left articular mass of the atlas has decreased. (*B*) *Rotation to the right:* Increase in the medial offset of the left articular mass. Slight medial offset of the right articular mass. (*C*) *Rotation to the left:* Slight increase in the medial offset of the left articular mass. Moderate medial offset of the right articular mass.

rotation of the head. He stated that he definitely did not have these symptoms before his injury. *Motion study of the atlanto-axial joint. Neutral position:* Slight medial offset of the left articular mass of C 1 was still present. *Rotation of the head to the right and left* produced essentially the same motion as on May 9, 1955.

Comment. Following a moderately severe injury, which was accompanied by neuro-

logic findings referable to the upper cervical cord, a left unilateral medial offset of the atlas was demonstrated. A motion study showed that (1) rotation to the left caused no change in the offset of the left articular mass but did produce an offset of the right articular mass, and (2) rotation to the right produced an increase in the medial offset of the left articular mass but failed to produce the expected medial offset of the right articular mass.

During a four-month period of observation the patient's symptoms diminished though he continued to complain of pain and limitation of rotation of the head. Slight unilateral medial offset persisted. Repeated motion studies showed no real change from the original examination though there was a slight increase in the range of motion.

DISCUSSION

It is believed that these 4 cases represent a little known syndrome which may best be termed rotational subluxation of the atlanto-axial joint. Though rotatory dislocations were described as early as 1907, the first study dealing with the subject in any detail was published by Coutts[5] in 1934. He observed and described cases similar to ours. He noted unilateral displacement of one of the articular masses of the atlas in his cases and stated that this finding was difficult to interpret, and was significant only when the head was held erect. "Under these conditions, a unilateral displacement represents a pathologic fixation in a position within the normal range of motion." He also stated that all of his cases occurred with trivial trauma and that all recovered. Simons[12] has also briefly mentioned rotatory subluxation. As noted previously, Buetti[2,3] employed functional studies similar to ours with the exception that he did not use laminagraphy. He described the case of a ten year old boy who had a rotatory subluxation which disappeared after one month. He emphasized that motion studies were essential for the diagnosis.

Rotational subluxation of the atlanto-axial joint is characterized roentgenographically by (1) unilateral medial offset of the atlas, and (2) abnormal rotatory motion of the atlanto-axial joint.

To evaluate these changes, the appearance of the normal atlanto-axial joint in the anteroposterior projection during rotation must be kept clearly in mind. (1) With slight or moderate rotation of the head to one side, there is medial offset of the ipsilateral articular mass of the atlas, and little or no medial offset of the contralateral mass. (2) In general, the amount of offset of the ipsilateral mass will exceed that of the contralateral mass.

Based on this concept, unilateral medial offset indicates rotation of the atlas on the axis, and its occurrence in the absence of rotation of the head is abnormal in the vast majority of instances. We have encountered only one instance of significant unilateral medial offset in which there was normal rotatory motion. Since it is difficult to prevent slight rotation of the head during examination, offsets of less than 1 mm. cannot be properly evaluated and may be assumed to be within normal limits. Pseudo-offsets due to variations in size of opposing articular surfaces do occur, but these can usually be distinguished readily from true offsets.

In all 4 of our cases the unilateral medial offset was present on more than one examination. In Case I and Case II the offset disappeared after several days; in Case III it was unchanged two and one-half months later, and in Case IV the offset was still present, though diminished, four months after injury.

The rotatory motion of the atlanto-axial joint was abnormal in each of these four cases.

Cases I and III were quite similar in that there was marked limitation of motion of both articular masses of the atlas. This was most noticeable when the head was

rotated to the side opposite to the offset. Then the ipsilateral articular mass failed to rotate posteriorly, while the offset of the contralateral mass disappeared in Case I and was unchanged in Case III. We believe that the articular mass of the atlas on the side of offset was subluxated posteriorly in both of these cases.

In Case I, motion returned to normal several days after injury and in Case III, the abnormal motion persisted during the period of observation, two and one-half months.

In Case II, a motion study made three days after injury showed a complete lack of rotatory motion in the atlanto-axial joint. Several days later the motion returned to normal.

In Case IV, motion of the articular masses of the atlas was almost exactly the opposite of normal. Rotation to either side increased the offset of, or produced an offset in, the contralateral articular mass rather than the ipsilateral mass. To explain these findings, we believe that the articular mass on the side of offset was subluxated anteriorly. During four months, this abnormal motion did not change significantly.

In all 4 cases there was good correlation of the clinical and roentgen findings. Minimal pain, tenderness and limitation of motion were present in Cases I, II and III. In Case IV there was moderate to severe pain, tenderness and limitation of motion associated with neurologic changes. In Cases I and II, the patients became asymptomatic with the disappearance of the offset and return of the rotatory motion to normal. In Cases III and IV, both the symptoms and abnormal roentgen findings have persisted.

Although rotatory subluxation of the atlanto-axial joint appears to be a definite roentgenologic entity, at the present time we may only speculate as to its clinical significance. Only a few cases have been reported and, excepting for 2 of ours, all are said to have recovered fully. Careful and prolonged clinical and roentgenographic follow-up will be necessary to determine the eventual outcome of these cases. We suspect that in some instances in which the subluxation persists chronic degenerative changes may develop.

SUMMARY

The anatomic characteristics of the atlanto-axial joint are such that its primary function is rotation rather than flexion and extension. Consequently, injury to this segment frequently results in fractures and dislocations which differ in pattern from those encountered elsewhere in the spine. The special roentgenographic procedures (1) refinements of conventional roentgenography, (2) laminagraphy, and (3) motion or functional studies, which are required for the examination of the atlanto-axial joint following injury, are discussed.

Four cases of rotational subluxation are presented. This is characterized roentgenographically by (1) medial displacement of one articular mass of the atlas with respect to the corresponding mass of the axis (unilateral medial offset) and (2) abnormal rotatory motion of the atlanto-axial joint.

George Jacobson, M.D.
1200 North State Street
Los Angeles 33, California

REFERENCES

1. ADLER, D. C., and JACOBSON, G. Radiographic study of rotatory motion of normal atlanto-axial joint. To be published.
2. BUETTI, C. Zur Darstellung der Atlanto-Epistropheal-Gelenke bzw. der Proc. Transversi Atlantis und Epistrophei. *Radiol. clin.*, 1951, *20*, 168–173.
3. BUETTI-BAUML, C. Funktionelle Röntgendiagnostik der Halswirbelsäule. Georg Thieme, Stuttgart, 1954.
4. CORNER, E. M. Rotary dislocations of atlas. *Ann. Surg.*, 1907, *45*, 9–26.
5. COUTTS, M. B. Atlanto-epistropheal subluxations. *Arch. Surg.*, 1934, *29*, 297–311.
6. CUNNINGHAM, D. J. Text-book of Anatomy. Eighth edition. Edited by BRASH, J. C., and JAMIESON, E. B. Oxford University Press, London, 1943.

7. DANKMEIJER, J., and RETHMEIER, B. J. Lateral movement in atlanto-axial joints and its clinical significance. *Acta radiol.*, 1943, *24*, 55–66.

8. JACKSON, H. Diagnosis of minimal atlanto-axial subluxation. *Brit. J. Radiol.*, 1950, *23*, 672–674.

9. JACOBSON, G., and ADLER, D. C. Evaluation of lateral atlanto-axial displacement in injuries of cervical spine. *Radiology*, 1953, *61*, 355–362.

10. PAUL, L. W., and MOIR, W. W. Non-pathologic variations in relationship of upper cervical vertebrae. AM. J. ROENTGENOL. & RAD. THERAPY, 1949, *62*, 519–524.

11. DE SEZE, S., DIJIAN, A., and MARTIN, M. De l'utilité des épreuves radiologiques fonctionelles dans les traumatismes cervicaux (atlas-axis). *Rev. du Rhumatisme*, 1951, *18*, 99–104.

12. SIMONS, B. Röntgendiagnostik der Wirbelsäule. Second edition. Gustav Fischer, Jena, 1951.

Vol. 76, No. 6

SECONDARY OSSIFICATION CENTERS AND THE INTRA-ARTICULAR OSSICLE

By LEE A. HADLEY
SYRACUSE, NEW YORK

EXCELLENT reports of these small persistent epiphyses have been published by various writers and the possibility of confusing them with fracture has been emphasized. They are of some anatomic interest however, and may, under certain conditions, be the cause of symptoms. Secondary ossification centers appear as small epiphyses at the tips of the spinous, transverse and articular processes early in the second decade. They become united with the vertebral body between the sixteenth and twenty-first years. The bony rings at the upper and lower surfaces of the vertebral bodies likewise are secondary centers and furnish attachment for strong ligamentous structures without interfering with the underlying bony growth.

Specimen 53-13 in the anatomy department of New York State Medical College at Syracuse was taken from a male sixty-two years of age (Fig. 1). There were small ossicles 6 × 10 mm. at the tips of the inferior articular processes of the first lumbar vertebra. These were oval with smooth and rounded surfaces. They were firmly incorporated in the capsular ligament and possessed a complete cortex with an articular cartilage on the anteromedial surface. They articulated with both the superior and inferior processes at the L_1 posterior articulation.

Farmer,[3] in a study of 2,535 spine roentgenograms found persistent secondary ossification centers in 1.5 per cent. In his review of 40 cases, all of them with ossification centers in the lumbar region, the inferior articular process was involved in over 92 per cent. Most of those reported have been on the second or third lumbar

FIG. 1. Specimen 53–13. Male, aged sixty-two. Bilateral ununited secondary ossification centers at tips of the L_1 inferior articular processes (arrows). This is the most common type of ununited secondary center and is probably without clinical significance.

FIG. 2. Oblique roentgenogram of specimen 53–13 to show the ununited ossicle on the right side. Note smooth rounded corners and sharply delineated cortex (arrow).

Fig. 3. Male, aged fifty. Accident two and one-half years before, fracture of all lumbar transverse processes on the left. Probable fracture of right L_3 inferior articular process (arrow). Note irregularity of cleavage line.

vertebra. Hipps[6] in reviewing 36 additional cases reported 20 per cent of them bilateral, 70 per cent on the right side, and involvement of the superior facets in only 5.5 per cent. Eighty-one per cent of his cases were males.

Incompletely united ossification centers may show a notching on the medial side of the inferior articular process. Multiple small ossicles may appear in the place of the ununited center. The upper and lower tips on the same joint may be ununited.

While the condition is ordinarily not painful, Hipps[6] removed such an ossicle from the tip of the right third lumbar inferior articular process in a young man twenty-four years old, who had sustained a disabling injury to the back eleven weeks previously. The author concluded from the appearance of the cartilage that the ossicle was an "ununited epiphyseal structure."

Fractures of the inferior articular process occur rarely. Mitchell[7] has reported 5

Fig. 4. Male, aged forty-three. Ununited D_1 transverse process tip (arrow). Asymptomatic. Said to be present in 0.7 per cent of all adult spines.

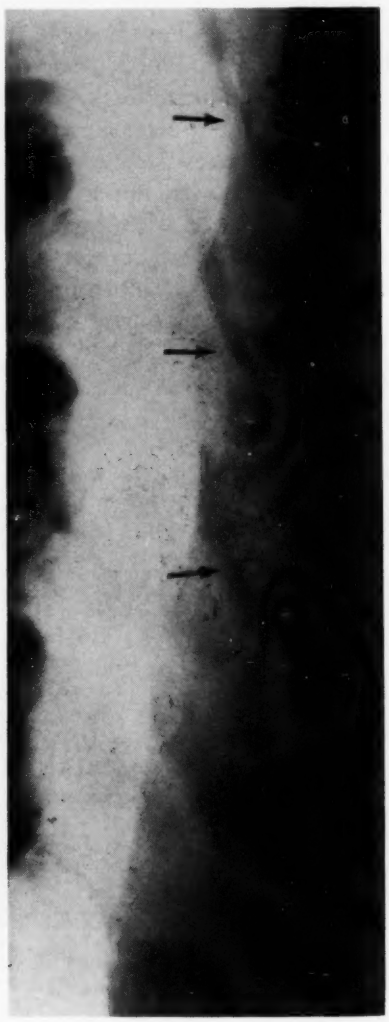


Fig. 5. Male, aged forty-six. Ununited centers at tips of seventh, eighth and ninth dorsal spinous processes (arrows).

FIG. 6. Female, aged forty-six. Two ununited centers for the bifid third cervical spinous process (arrow). Upon an earlier examination following an automobile accident resulting in injury to the back, these ossicles were diagnosed as ununited fractures. A critical evaluation, however, should have avoided this mistake.

FIG. 8. Female, aged forty-one. The left 5–6 posterior cervical articulation is separated to about three times its normal width. Within this enlarged joint is a slender intra-articular ossicle (arrow). Good stereoscopic films aid materially in visualizing these structures. The ossicle (retouched) is 3×8 mm.

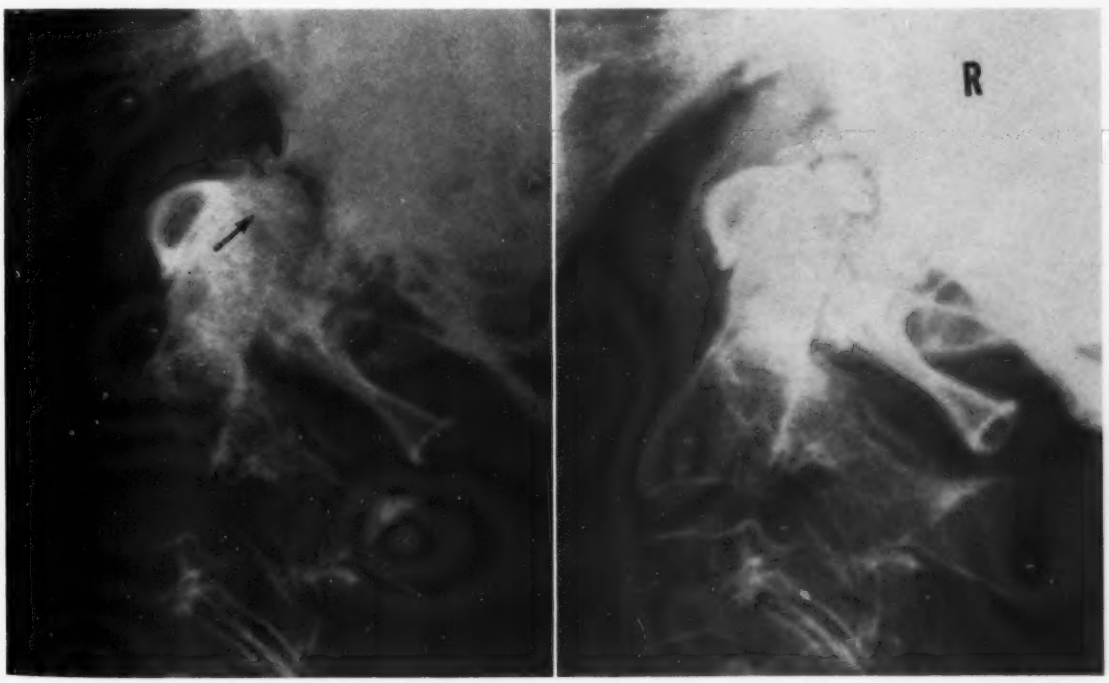


FIG. 7. Female, aged sixty-five. *Left:* Ossiculum terminale at tip of the odontoid (arrow). This center develops in the terminal ligament of the dens at about two years and normally unites at about 12 to form the tip of the odontoid. In this individual it is seen as a separate oval body 5×8 mm. in size just above and behind the tip of the odontoid. There are two smaller ossicles in front of it, apparently within the atlanto-occipital membrane. *Right:* R is a retouched roentgenogram of this same area to indicate the ossiculum terminale.

instances, all in males. They follow marked trauma, usually of a rotary character with the spine flexed. They produce severe pain and localized point tenderness. There is nonunion of the detached fragment with no attempt at callus formation. The fracture line crosses the cortex, it is likely to be serrated and there is absence of smooth cortical thickening on each side of the line. The detached fragment does not appear as a smooth rounded ossicle and may be displaced (Fig. 3).

Nonunion of the secondary ossification center at the tip of the first dorsal transverse process is said to occur in 0.7 per cent of all adult spines.[4] It does not usually show as dense a cortex as the one here illustrated (Fig. 4). There is likely to be some irregularity of the cleavage line so that confusion may arise if the patient has sustained a recent accident.

Persistent ossification centers at the tips of the spinous processes may become traumatized by a fall upon the back or down stairs. The patient complains of finger point tenderness, but the roentgenogram reveals the ossicles to be separate structures. If a fracture actually does occur it is likely to be near the middle of the spinous process. The spontaneous "shoveler's" fracture seen at the cervicodorsal level in patients of inadequate physique is a fatigue fracture of this type.[5]

Fig. 9. Same patient as Figure 8. Partially intra-articular ossicle at the left third lumbar articulation resulting from the ununited fourth superior articular process tip (arrow). Occurrence at the superior tip and in a female are two unusual features.

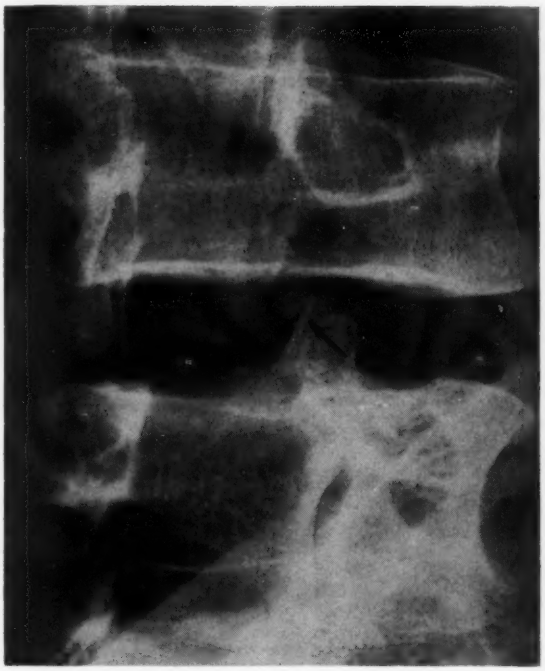


Fig. 10. Male, aged thirty-five (retouched). Intra-articular ossicle 5×9 mm. within a widened fourth lumbar posterior articulation (arrow). There was some widening of the corresponding joint on the opposite side. Intra-articular ossicles are usually painful.

The ossiculum terminale is an ununited center at the tip of the odontoid. This center normally develops in the terminal ligament of the dens during the first decade and later unites to form the tip of the odontoid. In its normal position it lies well anterior to the spinal cord and therefore is of anatomic rather than clinical interest (Fig. 7).

An intra-articular ossicle may develop if the ununited secondary ossification center

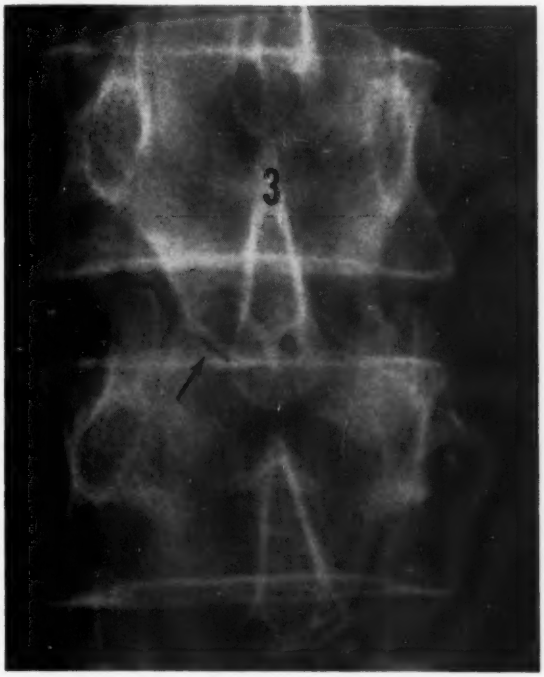


Fig. 11. Female, aged forty-nine. Left lumbar pain, aching and "crackling" sensation aggravated by bending backward or to the left. Not painful bending forward or to the right. This patient has a cleavage (arrow) between the third left inferior articular process and the corresponding lamina. This unilateral ununited secondary center is somewhat larger than usually encountered.

assumes a position between the articular processes (Fig. 8). These structures are forced apart and the posterior joint space is widened. The widening may be unilateral or bilateral, and the stability of the joint is lessened. The condition is likely to be painful with resultant muscle spasm. The ossicle may be only partially between the two articular surfaces as seen in Figures 9 and 12. Both of these were painful.

Rarely, the cleavage line for the ununited secondary ossification center is found more proximally. In Figure 11 it is seen between the inferior articulation and the lamina. Hipps[6] has also reported such a case in an adult, bilaterally at L_3. Roche and Rowe[9] likewise reported a similar congenital case in a seven and one-half months fetus with separate centers for the right second and third inferior articular processes. In Batt's[2] specimen of an early fetus an accessory center was present on the right side of L_3, but whether the cleavage was through the isthmus or below the lamina could not yet be determined. A cleavage line, which may or may not be congenital, is occasionally seen at the isthmus. Schmorl and Junghanns[10] observed such a case at L_3. Oppenheimer[8] reported 2 such unilateral cases in adults at L_2. Two patients of this author have shown the condition bilaterally at L_2 with separate ossicles medial to the cleavage line. All of these cases as well as the majority of the persistent ununited tips occurred at the L_2 or L_3 level.

Other secondary centers to be mentioned in passing, although without clinical significance, are the small midline ossicles overlying the deficiency in cases of spina bifida occulta, those centers lying alongisde the sacrum, the rudimentary ribs at L_1, or the ununited ring epiphysis of the vertebral

Fig. 12. Oblique view same patient as Figure 11. The ununited center has produced a very large intra-articular ossicle which seems to be displaced downward (arrow).

Fig. 13. Female, aged sixty plus. Bilateral defect in the isthmus or pars interarticularis of L_2. This appears almost like an articulation between the pedicle and the spinous process. This case is similar to that cited by Schmorl and Junghanns,[10] page 26, Figure 45. Note the ununited vertebral ring epiphysis at the lower anterior corner of L_2.

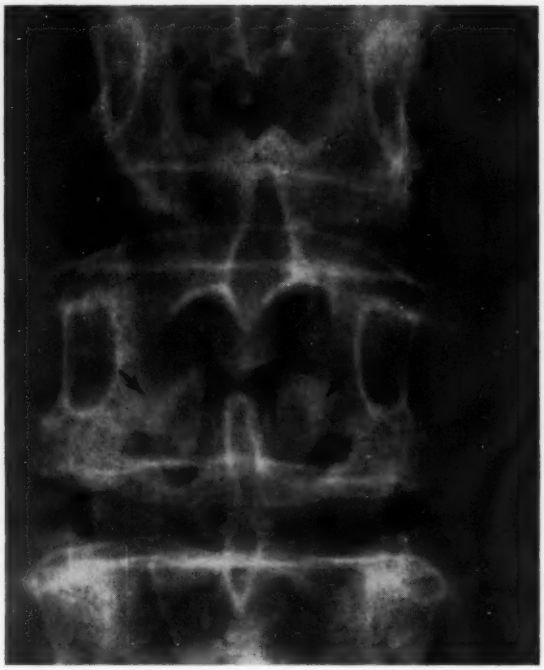


Fig. 14. Posteroanterior view same patient as Figure 13. Separate ossicles (arrows) appear medial to the defects in the arch of L_2. These are similar to those reported by Oppenheimer.[8]

body which appears as a triangular shadow at the upper or lower anterior corner of the vertebra (Fig. 13). This latter, the so-called "limbus bone," is not to be confused with an intercalary ossicle which sometimes forms as a separate bony fragment within the longitudinal ligament.

SUMMARY

1. Ununited secondary ossification centers for the various spinal processes most commonly occur in men and usually involve the second or third lumbar inferior articular process.

2. Fracture of the articular process may occur but follows a severe accident and results in disabling pain with finger point tenderness.

3. The ossiculum terminale is an asymptomatic persistent center at the tip of the odontoid process.

4. The intra-articular ossicle is described as a small bone within the joint. The articular surfaces are held apart and the condition is likely to be painful.

5. A cleavage line at the base of the inferior articular process or through the pars interarticularis may be encountered in the upper lumbar region.

925 State Tower Building
Syracuse 2, New York

Appreciation is extended to the Departments of Anatomy and Photography at New York State University, College of Medicine at Syracuse, for assistance in the preparation of this material.

REFERENCES

1. Bailey, W. Persistent vertebral process epiphyses. Am. J. Roentgenol. & Rad. Therapy, 1939, *42*, 85–90.
2. Batts, M., Jr. Etiology of spondylolisthesis. *J. Bone & Joint Surg.*, 1939, *21*, 879–884.
3. Farmer, H. L. Accessory articular processes in lumbar spine. Am. J. Roentgenol. & Rad. Therapy, 1936, *36*, 763–767.
4. Graberger, G. Quoted by Schmorl and Junghanns[10] page 27.

5. Hall, R. D. McKellar. Clay-shoveler's fracture. *J. Bone & Joint Surg.*, 1940, *22*, 63–75.
6. Hipps, H. E. Fissure formation in articular facets of lumbar spine. *J. Bone & Joint Surg.*, 1939, *21*, 289–303.
7. Mitchell, C. L. Isolated fractures of articular processes of lumbar vertebrae. *J. Bone & Joint Surg.*, 1933, *15*, 608–614.
8. Oppenheimer, A. Supernumerary ossicle at isthmus of neural arch. *Radiology*, 1942, *39*, 98–100.
9. Roche, M. B., and Rowe, G. G. Anomalous center of ossification for inferior articular processes of lumbar vertebrae. *Anat. Rec.*, 1951, *109*, 253–259.
10. Schmorl, G., and Junghanns, H. Die gesunde und kranke Wirbelsäule im Röentgenbild. Georg Thieme, Leipzig, 1932.

FRACTURE DISLOCATION OF THE ANKLE WITH FIXED DISPLACEMENT OF THE FIBULA BEHIND THE TIBIA*

By JOHN J. FAHEY, M.D., LEO T. SCHLENKER, M.D.
CHICAGO, ILLINOIS
and
RICHARD C. STAUFFER, M.D.
FORT WAYNE, INDIANA

IN 1947 Bosworth described 5 cases of fracture dislocation of the ankle joint seen during a period of eighteen months in which closed reduction had been unsatisfactory, and at operation a condition was found which, to the authors' knowledge, had not been previously reported. Closed reduction failed in 2 of these cases seen by the authors soon following the injury, and at operation the lower end of the upper fibular fragment was found to be displaced behind the posterolateral edge of the tibia and was so tightly held by the interosseous membrane that a pry was necessary to dislodge the fragment. A screw was used to fix the fibula in both cases and in 1 of these the internal malleolus was similarly fixed. Two of the 3 cases that consulted the authors several months following closed reduction were treated by arthrodesis. Another case seen nine months following the initial treatment was reported progressing satisfactorily after open reduction and fixation of the fibular fragment with a screw.

In discussing the mechanism of the syndrome, Bosworth believed that during the twisting force at the ankle, the lateral collateral ligaments draw the intact fibula behind the tibia where it is broken off against the posterior tibial border and that it is impossible to force the upper fibular fragment back over the posterolateral ridge on the lower tibia because of the intact interosseous membrane.

If one is on the alert for this syndrome, futile attempts at closed reduction will be avoided and additional damage will not be superimposed on an already severely traumatized joint. As no subsequent reports have appeared since the original description by Bosworth, the authors wish to reemphasize the importance of careful interpretation of roentgenographic views of the ankel in fracture dislocation in order to recognize the condition by reporting 3 cases which illustrate the various problems encountered.

REPORT OF CASES

CASE 1. E. H., a forty-six year old man, was admitted to St. Francis Hospital complaining of pain and deformity of his right ankle following a twist of the ankle while playing baseball. The foot was externally rotated 90° and was displaced posteriorly. There was considerable swelling about the ankle and the foot had a reddish cyanotic appearance.

Anteroposterior roentgenogram made of the lower leg and ankle region (Fig. 1*A*) showed outward rotation of the foot on the ankle with displacement of the ankle mortise and superimposition of the fibula on the outer portion of the tibia. The lateral view (Fig. 1*B*) showed the sharp point of the lower end of the upper fibular fragment posterior to the tibia just proximal to the joint line. The lower fibular fragment was displaced posteriorly from the fibular notch of the tibia and the astragalus was displaced backwards from its normal tibial mortise.

Anteroposterior roentgenogram (Fig. 1*C*) following closed reduction and cast immobilization showed some tibio-astragalar diastasis with outward displacement of the lower fibular fragment. The slight amount of superimposition in this view would not be diagnostic, but the lateral view (Fig. 1*D*) still showed the

* From the Department of Orthopedic Surgery, St. Francis Hospital, Evanston, Illinois.

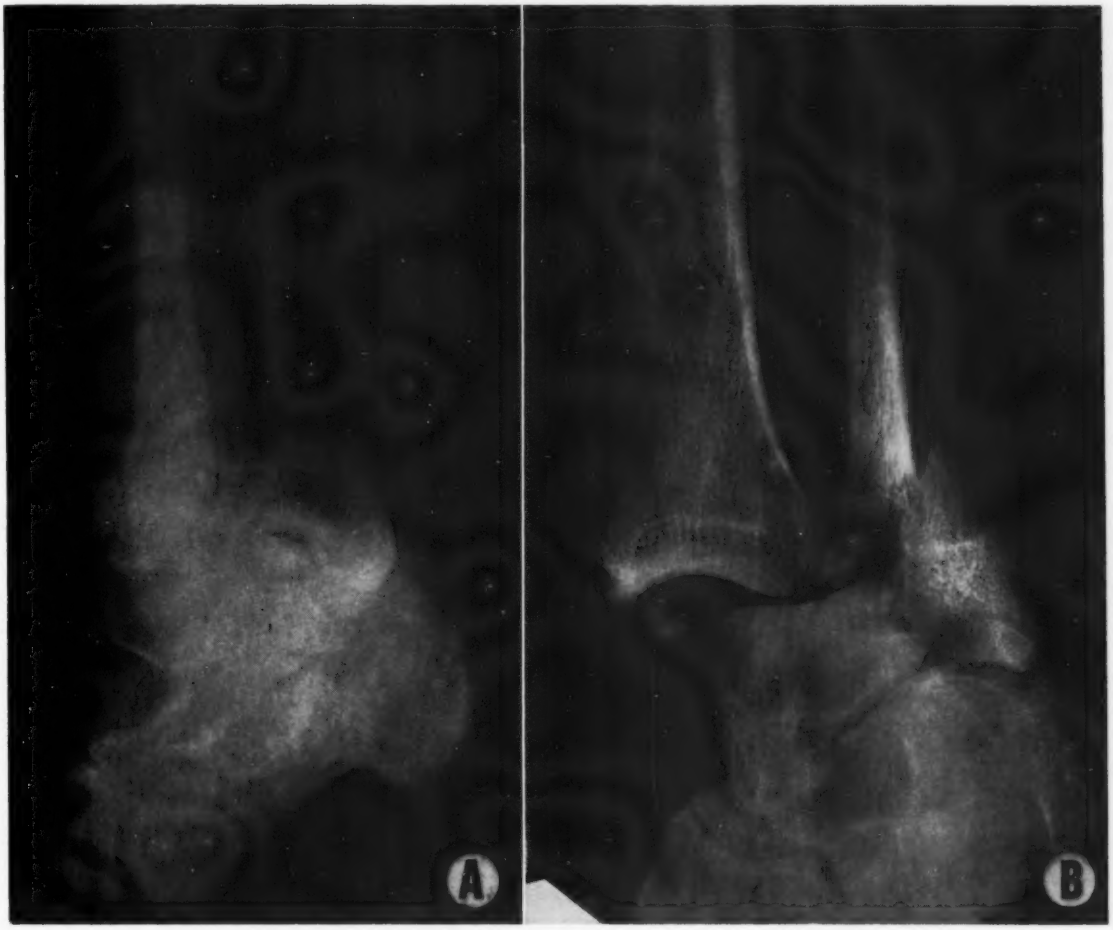


Fig. 1. (*A*) Anteroposterior view of the right ankle region shows superimposition of the fibula on the outer portion of the tibia and external rotation of the foot, and displacement of ankle mortise. (*B*) Lateral view of the right ankle showing the tibio-astragalar dislocation and a fracture of the lower fibula with the sharp spicule of the lower portion of the upper fibular fragment impinged on the posterior aspect of the tibia just above the articular surface.

lower end of the upper fibular fragment displaced posterior to the tibia. Roentgenograms made following a second manipulation showed overlap of the upper fibular fragment on the outer portion of the tibia in the anteroposterior view (Fig. 1*E*) and partial superimposition in the lateral view (Fig. 1*F*) as well as posterior subluxation of the astragalus on the tibia. We did not believe that the locked upper fibular fragment had changed position following the manipulations, and the apparent change was due to the variance in true views of the ankle.

Operation was then carried out and the fracture exposed by an incision over the lower fibula. The lower end of the upper fibular fragment was firmly locked behind the posterior ridge of the fibular notch of the tibia and on the lateral portion of the posterior and distal flat surface of the tibia. The lateral malleolar ligaments were ruptured and the lower portion of the interosseous membrane was torn. The lower end of the upper fibular fragment snapped back from its tightly lodged position in back of the tibia after considerable force had been used to dislodge it.

Examination of the patient four and one-half years following injury revealed that the patient had no complaint referable to his ankle except that he recognized motion was somewhat restricted and at times had noticed discomfort on excessive activity. Examination showed loss of the last 5 to 10° of dorsiflexion and a similar loss of the range of ankle extension. He had loss of inversion and eversion at

FIG. 1. (*C*) After first attempt at closed reduction and cast immobilization, there is only superimposition of a small portion of the fibula on the tibia on the anteroposterior view (not diagnostic). There is outward displacement of the lower fibular fragment and diastasis between the internal malleolus and astragalus. (*D*) The later view shows displacement of the lower end of the upper fibular fragment behind the tibia.

the subastragalar joint and some restriction in the region of the mediotarsal joints. Roentgenograms made of the ankle and foot at this time (Fig. 1, *G*, *H* and *I*) showed some degenerative arthritic changes of the astragaloscaphoid and the scaphocuneiform joints.

CASE II. H. D., a forty-seven year old man, was admitted to St. Francis Hospital on January 4, 1952, following an injury to his left ankle when he stepped from a curb onto snow-covered ice. He was not aware of the exact mechanism of injury. The foot was externally rotated and displaced posteriorly. There was some circulatory embarrassment of the foot as evidenced by cyanosis and decreased temperature.

Anteroposterior roentgenogram of the ankle (Fig. 2*A*) showed external rotation of the foot and the overlapping of bony shadows at the ankle indicating dislocation. The lower portion of the upper fibular fragment was superimposed on the outer aspect of the tibia. The lateral view (Fig. 2*B*) showed the posterior dislocation of the astragalus from the tibia. The fracture extended from the joint level upward and posteriorly, and the lower spicule of the upper fibular fragment was only slightly superimposed on the tibia.

Gentle traction without anesthesia appeared to reduce the fracture dislocation. Palpation of the lower fibular region, however, revealed a prominent lower fragment and the absence of the normal contour in the region of the upper fibular fragment.

Roentgenograms following reduction showed in the anteroposterior view (Fig. 2*C*) superimposition of the upper fibular fragment on the midportion of the tibia and some diastasis between the internal malleolus and the astragalus, and in the lateral view (Fig. 2*D*) a spirally fractured lower end of the upper fibular frag-

Fig. 1. (*E*) Roentgenograms following second manipulation show overlap of upper fibular fragment on outer portion of tibia on the anteroposterior view and (*F*) partial superimposition on the lateral view with posterior subluxation of the astragalus on the tibia.

ment posterior to the tibia, near the joint line.

Operation was carried out and the fractured site was exposed through a lateral incision 3 inches long. The lower fibular fragment was loose. The malleolar ligaments were ruptured and the fracture line extended upward and posteriorly and medially from the joint line. The lower portion of the interosseous mem-

Fig. 1. (*G*, *H* and *I*) Anteroposterior and lateral roentgenograms of the ankle and foot four and one-half years after open reduction. There are degenerative changes of the astragaloscaphoid and the first scaphocuneiform joints.

FIG. 2. (*A*) Anteroposterior view of the left ankle shows overlapping of shadows of tibia and astragalus and the lower portion of the upper fibular fragment is superimposed on outer aspect of the tibia. (*B*) Lateral view shows posterior dislocation of the astragalus on the tibia and slight superimposition of the lower end of the upper fibular fragment on the tibia.

brane was torn and the pointed spicule of the lower end of the upper fibular fragment was held tightly behind the midportion of the flat posterior distal surface of the tibia just above the joint line. Considerable force was necessary to disengage the fragment and then it snapped into position. One screw was used for internal fixation of the fibula and the extremity was immobilized in a cast.

At the last examination, sixteen months following the injury, the ankle region was enlarged and motion was considerably restricted. Dorsiflexion and plantar flexion of the ankle were limited to half that of normal. Lateral motion of the ankle was even more restricted. There was a 10° flexion deformity of the interphalangeal joint of the big toe, and flexion of the toe could not be accomplished even passively, and forced motion caused the extensor hallucis tendon to bowstring as it appeared fixed by adhesions in the ankle region. In spite of this the patient stated that he was only slightly handicapped when going up and down stairs and experienced no pain while walking.

Anteroposterior and lateral roentgenograms (Fig. 2, *E* and *F*) made at this time showed

satisfactory position and there was no evidence of degenerative arthritic changes in the ankle or tarsal bones.

Case III. J. A., a twenty-seven year old man, was seen by one of us (R. S.) soon after he had sustained a severe external twisting force of his right foot while playing baseball. The ankle was swollen and deformed and the foot externally rotated.

Roentgenograms (Fig. 3, *A* and *B*) taken in the anteroposterior and lateral views showed a spiral fracture of the fibula extending upward, backward and medially from the joint line with posterior and lateral dislocation of the astragalus. Since neither view was a true view, displacement of the lower end of the upper fibular fragment was not demonstrated posterior to the tibia in either view. Roentgenograms made after the first attempted reduction (Fig. 3, *C* and *D*) in true views showed some posterior and lateral displacement of the astragalus, but posterior displacement of the fibula was indicated in the two views by superimposition on the outer tibia in the anteroposterior view and a posterior

Fig. 2. (*C*) Roentgenograms following manipulation show superimposition of the upper fibular fragment on the mid portion of the tibia in the anteroposterior view with diastasis between the internal malleolus and astragalus. (*D*) Lateral view shows a spirally fractured lower end of the upper fibular fragment posterior to the tibia, near the joint line.

FIG. 2. (*E* and *F*) Anteroposterior and lateral views of the ankle made sixteen months following open reduction. No degenerative changes of the ankle or tarsal joints were demonstrated.

FIG. 3. (*A* and *B*) Anteroposterior and lateral views show a spiral fracture of the fibula extending upward, backward and medially from the joint line with posterior and lateral dislocation of the astragalus. Neither of these views are true views and do not demonstrate the lower end of the upper fibular fragment posterior to the tibia in either view.

FIG. 3. (*C*) True views show posterior and lateral displacement of the astragalus but posterior displacement of the fibula is indicated on both views by superimposition on the anteroposterior view on the outer tibia. (*D*) The lateral view shows the distal end of the upper fibular fragment just above the joint line and behind the tibia.

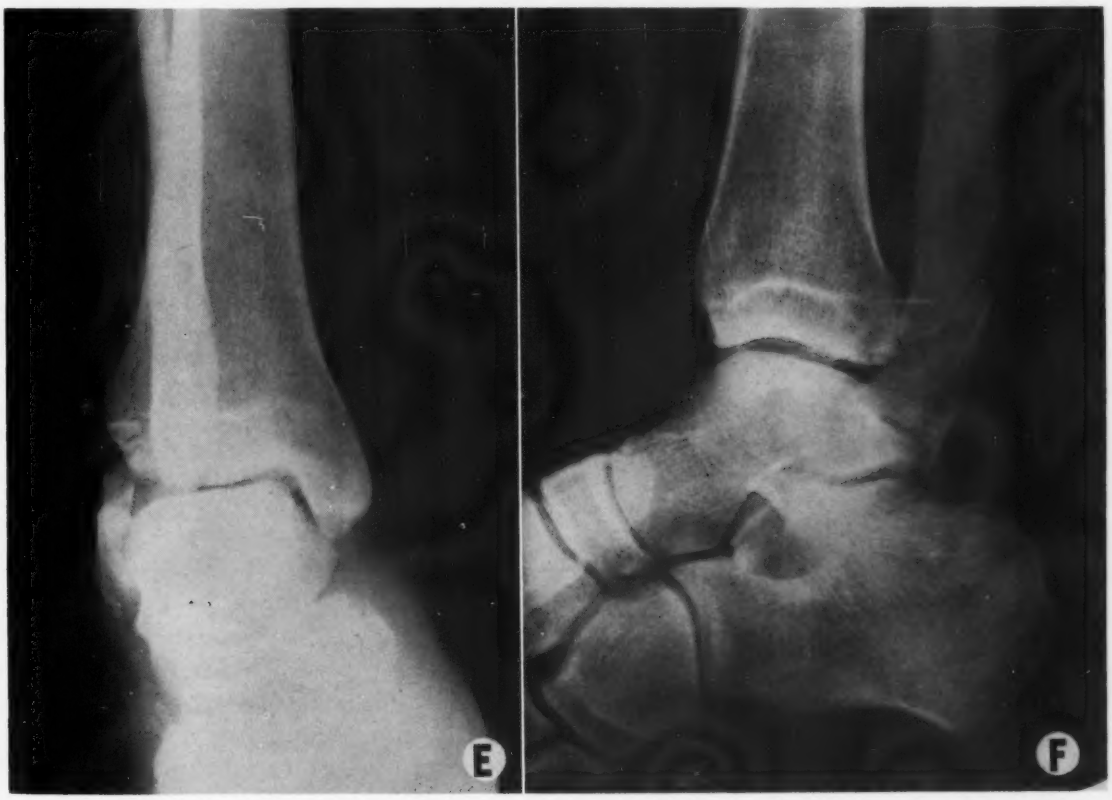


FIG. 3. (*E* and *F*) After remanipulation anteroposterior and lateral views show the relationship of the ankle mortise satisfactorily, but superimposition is present on the anteroposterior view and posterior displacement of the fibula on the lateral view.

Fig. 3. (*G* and *H*) Anteroposterior and lateral view roentgenograms made five months following open reduction show satisfactory reduction.

displacement with the distal end of the upper fibular fragment just above the joint line in the lateral view. After remanipulation anteroposterior and lateral views (Fig. 3, *E* and *F*) showed the relationship of the ankle mortise to be satisfactory, but the posterior impingement of the fibular fragment was still present.

Open reduction was performed and the lower end of the upper fibular fragment was tightly held on the posterior distal tibial surface in close proximity to the joint.

Anteroposterior and lateral roentgenograms made five months following open reduction (Fig. 3, *G* and *H*) showed satisfactory reduction.

Fourteen months following reduction the patient complained of intermittent numbness and coldness of the foot. There was stiffness of the ankle noticed on arising in the morning which gradually subsided with activity. The foot was reddish in color as compared to the uninjured side in the dependent position. There was some brownish pigmentation of the skin about the ankle. Tibial pulsations were normal and there was only minimal swelling. Dorsiflexion and plantar flexion were 75 per cent of normal and inversion and eversion were only half that of normal. All the toes were somewhat limited in motion especially on plantar flexion.

DISCUSSION

The posterior border of the triangular fibular articular surface on the distal lateral surface of the tibia is prominent only in its distal one-third. The upper two-thirds of the posterior boundary of the fibular notch are continuous with the posterior surface of the tibia which slopes anterolaterally. If the fracture occurs within this region, the fibular fragment is likely to slip forward into its normal position because of the sloping smooth surface and absence of a definite border.

In all 3 cases reported here, the lower end of the upper fibular fragment was locked on the flat tibial surface behind the promi-

nent lower posterior border within 1 cm. of the articular surface.

In an anteroposterior view of a normal ankle, the inferior tibiofibular articulation is not well demonstrated and there is overlap of only a small portion of the tibia on the fibula (Fig. 4*A*), while the lateral view shows complete overlap of the fibula on the tibia (Fig. 4*B*).

If the fibula is impinged just in back of the posterior ridge of the fibular notch, then it may not be obvious on the anteroposterior view (Fig. 4*C*) and only detected on the lateral view (Fig. 4*D*). However, if the displacement is near the middle of the tibia, the true anteroposterior view will readily visualize the superimposition (Fig. 4*E*), and the posterior displacement will be shown on the lateral view (Fig. 4*F*). If true anteroposterior and lateral views are not used, the overlap may not be demonstrated in the anteroposterior view (Fig. 3*A*) or the posterior displacement shown in the lateral view (Fig. 3*B*). When superimposition in the anteroposterior view and posterior displacement in the lateral view are seen, they are usually considered to be due to oblique positioning and the condition goes unrecognized.

Of the 5 cases reported by Bosworth and 1 described by R. I. Harris in discussing Bosworth's paper and the 3 reported here, only in 2 instances was the displacement of the tibia from the astragalus associated with a fracture of the lower tibia. The anterior and posterior inferior tibiofibular ligaments were torn in the 3 cases reported here. While none of these patients had any particular complaints when examined several months following treatment, they all had considerable permanent restriction of motion of the ankle or foot. One of our patients (Case 11) had only one manipulation before resorting to open

Fig. 4. (*A* and *B*) Anteroposterior and lateral views of the articulated bones of the skeleton showing normal relationship of the tibia and fibula at the ankle.

FIG. 4. (*C* and *D*) Anteroposterior and lateral views of the ankle with the fibula displaced just in back of the posterior border of the fibular notch. The superimposition is not noticeable to any appreciable degree in the anteroposterior view while the lateral view shows the true posterior displacement.

FIG. 4. (*E* and *F*) When the lower end of the upper fibular fragment is displaced near the middle portion of the tibia, it is very obvious on both views.

reduction, and he had a similar degree of permanent disability. The major portion of the permanent disability probably results from the type of fracture and severe twisting force producing it rather than the remanipulations.

SUMMARY

One should be on the alert for the syndrome of fixed displacement of the upper fibular fragment behind the tibia in instances of fracture dislocation of the ankle, particularly in cases where closed reduction fails. It is important to recognize the condition by careful examination of the roentgenograms and to correct it by open reduction.

John J. Fahey, M.D.
1791 West Howard Street
Chicago 26, Illinois

REFERENCES

1. Bosworth, D. M. Fracture-dislocation of ankle with fixed displacement of fibula behind tibia. *J. Bone & Joint Surg.*, 1947, *29*, 130–135.

THE OS SUSTENTACULI

By HERMAN C. MARCH, M.D., *and* RUSSELL I. LONDON, M.D.
PHILADELPHIA, PENNSYLVANIA

THE os sustentaculi was first described from an anatomic viewpoint by Pfitzner[10] in 1896. It is a small accessory bone lodged at the posterior end of the sustentaculum tali, slightly to the superior side. In conjunction with this he described a related condition in which there is a bony projection of the posterior portion of the sustentaculum tali surmounted by a similar projection from the medial tubercle of the talus and forming an accessory joint. He explained the latter situation as one in which the os sustentaculi had united with the posterior end of the sustentaculum tali. He presented only 1 case in which the os sustentaculi was an independent ossicle and 3 cases of the fused variety, despite a vast numerical experience in anatomic variants.

The condition was subsequently briefly mentioned by Hasselwander,[5] who called it a pseudoepiphysis of the sustentaculum tali, but presented no illustration. In 1934, Guntz[4] reported 2 cases, and was the first to present clinical data with them. The first was a twenty-two year old man with painful pronated feet, the left one of which showed a distinct triangular os sustentaculi, palpable clinically as a small projection beneath the medial malleolus. There was more restriction to attempted inversion on the left than on the right side. Similar clinical findings were present in the second case, a ten year old girl, and with similar roentgen findings. Guntz speculated upon the possibility that in the younger patient the os sustentaculi may fuse with the sustentaculum at the end of her growth period and may present the roentgen picture of the fused variety. Both patients were relieved by arch supports, but surgical removal of the accessory bone was proposed by Guntz should symptoms continue.

Burman and Sinberg[1] in 1940 described a patient with "double ankles," a clinical appearance caused by a second projection beneath the medial malleolus on each side. This was produced by the bilateral presence of the "fused" variety, or more properly, the articulatio talo-calcanea, in which bony enlargements at the posterior end of the sustentaculum tali and the superjacent talus formed an accessory joint space. This patient had minimal complaints, and there was noted only a very slight restriction of inversion on one side.

Grashey[3] in 1942 presented 2 cases, 1 of os sustentaculi and 1 of articulatio talo-calcanea. The former, a twenty-nine year old patient, had a fifteen year history of pain on the involved side. The latter was a thirty year old person with pain on the medial aspect of the ankle. In the same year Tretter[12] reported a thirty-nine year old patient with bilateral articulatio talo-calcanea who had had "weak feet" since childhood with more severe pains of one week's duration on the inner aspect of one ankle.

No other references could be found in the literature. There have been thus far 4 cases of os sustentaculi and 6 cases of articulatio talo-calcanea (1 of which was bilateral) reported altogether. The marked infrequency of this condition or its lack of recognition is attested to by the fact that neither Dwight[2] (1907) nor Marti[9] (1947) in their respective monographs and atlases on the variations of the bones of the feet were able to include an illustration of either the accessory ossicle or the accessory joint. Marti is apologetic for being unable to find an illustrative case in the material of the various university radiologic departments in Switzerland. Furthermore, none of the authors of standard roentgen texts describes this condition, except Shanks and Kerley,[11] who even in their second edition (1950) state that the os sustentaculi "has not been demonstrated roentgenographically, and its existence is

doubtful." Köhler[6] and Markovits[8] merely list it among other accessory bones.

Within a period of two weeks the authors encountered 2 cases of os sustentaculi. These 2 are being added to the four cases previously reported, since their marked rarity would indicate that the great majority of radiologists and orthopedists are probably not acquainted with this condition.

REPORT OF CASES

Case 1. G.P., an eleven year old male, complained of intermittent pain over the medial aspects of both feet and ankles for over a year. Pain was more pronounced when the feet were lifted during walking. There was tenderness just below the medial malleoli. As can be seen in Figure 1, there was visible and palpable a slight secondary projection just below and slightly posterior to each medial malleolus, and it was at this projection that the patient's discomfort was most concentrated. After arch supports were prescribed, the patient's symptoms were considerably relieved. The patient attributed this relief to the fact that the arch supports elevated his feet so that the tops of his shoes no longer rubbed on the medial projections.

Roentgenograms of the ankles in this case revealed the presence bilaterally of a small triangular ossicle visible in the anteroposterior projection just above, medial, and posterior to the posterior end

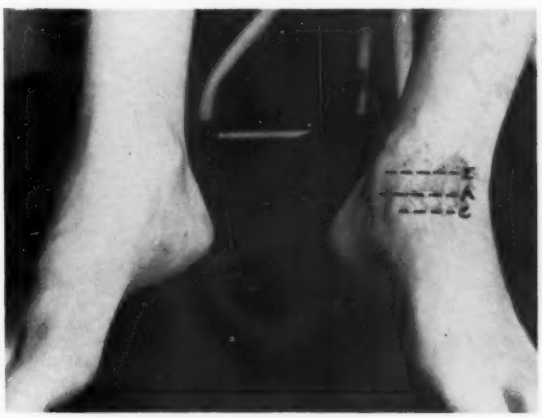


Fig. 1. Case 1. Both ankles show a small visible and palpable protuberance (A) just below and posterior to the medial malleolus (E), caused by the os sustentaculi. A similar protuberance (C) below and *anterior* to the medial malleolus is caused by the tuberosity of the navicular bone and the os tibiale externum when present.

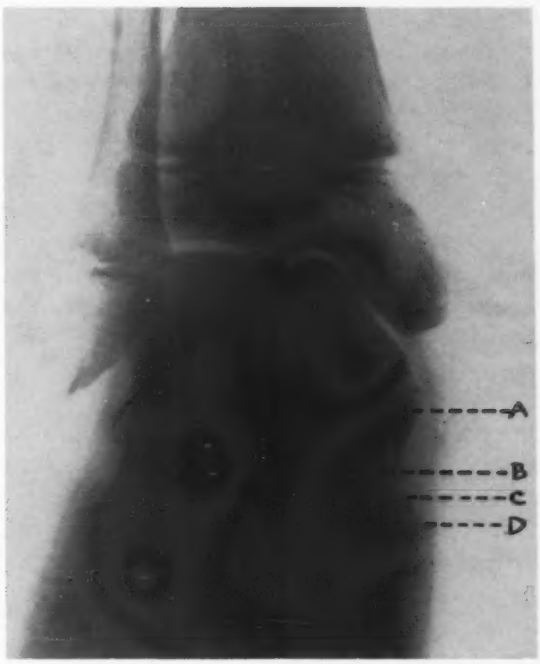


Fig. 2. Case 1. Anteroposterior roentgenogram of right ankle. (A) os sustentaculi; (B) sustentaculum tali; (C) navicular bone; (D) os tibiale externum. The same lettering code applies to all the figures.

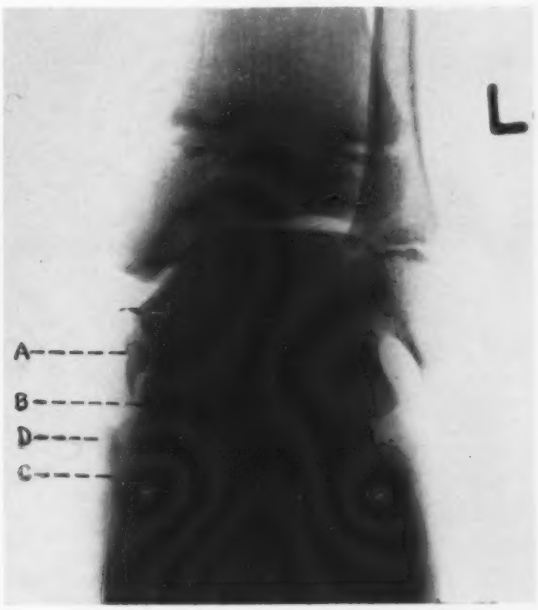


Fig. 3. Case 1. Minimal external rotation of left ankle.

of the sustentaculum tali (Fig. 2 and 3). This was best visualized when the foot was held in a very minimal external rotation (Fig. 4). With 45° external rotation the posterior relationship of this ossicle, the os sustentaculi, to the posterior end of the sustentaculum tali was better demonstrated (Fig. 5). In the lateral views (Fig. 6 and 7) one could not distinguish the ossicle, nor could a definite joint-space between the ossicle and the posterior margin of the sustentaculum tali be seen (such as illustrated by Grashey) owing to the superimposed presence of the lower tip of the fibula. This patient also had a small os tibiale externum bilaterally, and the relative position of the two ossicles in the anteroposterior view can be seen in Figures 2, 3 and 4. The os tibiale externum is at a lower level and lies adjacent to the posterior end of the tuberosity of the navicular bone. Clinically, of course, the projection produced by a well-developed os tibiale externum lies below and *anterior* to the medial malleolus and is thus readily distinguished from the projection caused by an os sustentaculi. In this patient, in-

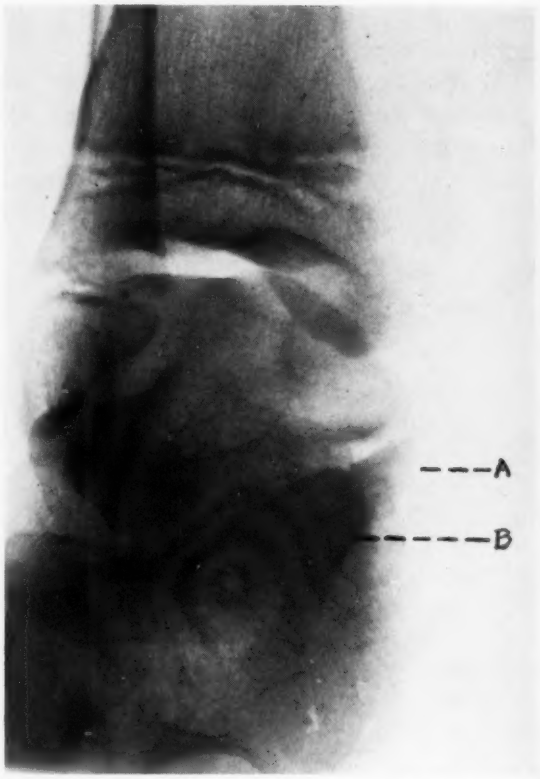


FIG. 5. Case 1. Routine (45°) external rotation of right ankle.

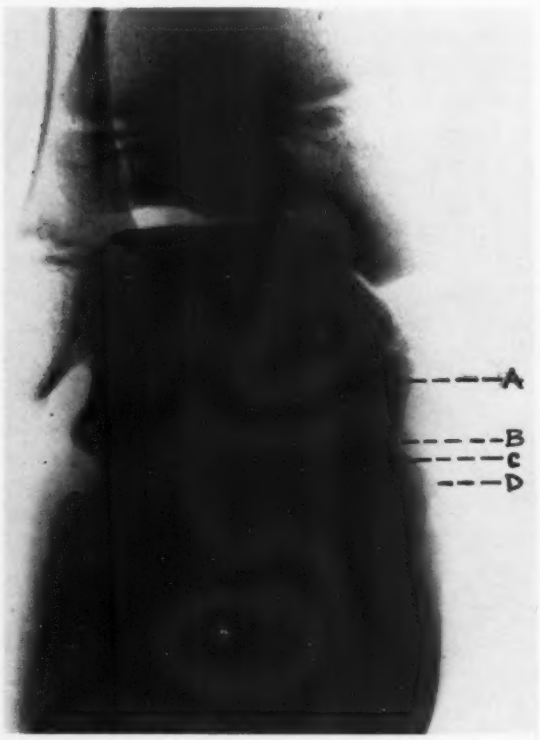


FIG. 4. Case 1. Minimal external rotation of right ankle.

FIG. 6. Case 1. Lateral view of left ankle.

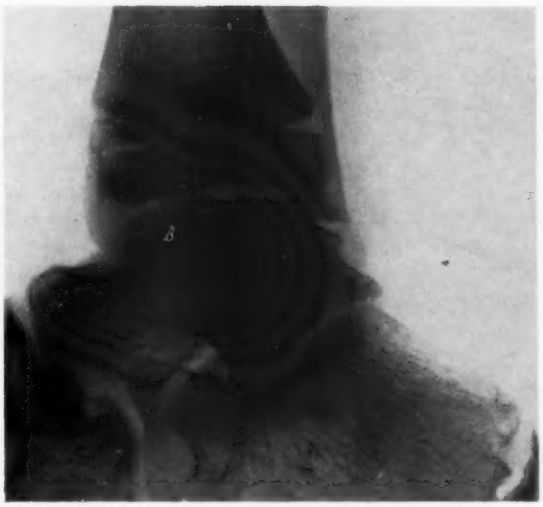


Fig. 7. Case I. Lateral view of right ankle.

deed, there can be seen in Figure 1 a slight projection caused by the os tibiale externum.

Case II. I. M., a twenty-five year old male, had been having some pains just below the medial malleolus of the right foot for about a year. There was a slight fullness just below the medial malleolus on inspection. There were no complaints referable to the left foot. Roentgenograms revealed two small ossicles or a divided ossicle in the typical position adjacent to the posterior margin of the sustentaculum tali (Fig. 8). This patient also was improved after the use of an arch support prescribed by one of us (R.I.L.).

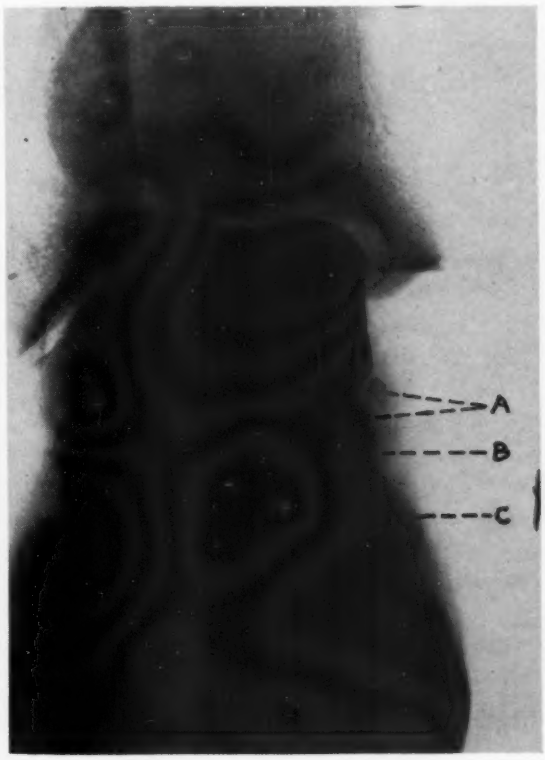


Fig. 8. Case II. Anteroposterior view of right ankle.

SUMMARY

1. The os sustentaculi is a small accessory ossicle at the posterior end of the sustentaculum tali.

2. It is apparently very rare or not being recognized.

3. Two cases are added to the 4 that have been reported in the literature, none having been reported in the American literature.

4. Articulatio talo-calcanea is a related condition and is apparently also quite rare, 6 cases having been reported, 1 in the American literature. It may represent the end result of a fusion of the os sustentaculi or its cartilaginous precursor to the sustentaculum tali.

5. The presence of an os sustentaculi can be accompanied by symptoms and is therefore of clinical significance.

6. The os sustentaculi produces a small visible and palpable projection just below and very slightly posterior to the medial malleolus, in contrast to the more anterior projection produced by an os tibiale externum.

7. Roentgenographically it can be visualized in an anteroposterior projection of the ankle, but is seen optimally with a very minimal amount of external rotation.

Herman C. March, M.D.
7222 Castor Avenue
Philadelphia 49, Pennsylvania

REFERENCES

1. Burman, M. S., and Sinberg, S. E. Anomalous talocalcaneal articulation; double ankle bones. *Radiology*, 1940, *34*, 239–241.
2. Dwight, T. Variations of the Bones of the Hand and Foot. J. B. Lippincott Co., Philadelphia, 1907.
3. Grashey, R. Articulatio talo-calcanea (Os

sustentaculi). *Röntgenpraxis*, 1942, *14*, 139–142.

4. GUNTZ, E. Klinische Beobachtungen eines seltenen akzessorischen Knochenkernes am Fussskelett, eines Os sustentaculi. *Zentralbl. f. Chir.*, 1934, *61*, 1206.
5. HASSELWANDER, A. Einige neue Gesichtspunkte für die Beurteilung der Skelettvarietäten des Tarsus. *Zeitschr. f. d. ges. Anat., Zeitschr. f. Konstitutionslehre*, 1922, *8*, 79.
6. KÖHLER, A. Roentgenology: The Borderlands of the Normal and Early Pathological in the Skiagram. Second English edition. Baillière, Tindall & Cox, London, 1935.
7. KORVIN. Coalitio talocalcanea. *Zeitschr. orthop. Chir.*, 1933, *60*, 105.
8. MARKOVITS, E. Bone and Joint Radiology. The Macmillan Company, New York, 1949.
9. MARTI, T. Die Skelettvarietäten des Fusses. Hans Huber, Bern, 1947.
10. PFITZNER, W. Beiträge zur Kenntniss des menschlichen Extremitätenskeletts. VII. Die Variationen in Aufbau des Fussskeletts. Schwalbes Morpholigsche Arbeiten, 1896, *6*, 245.
11. SHANKS, S. C., and KERLEY, P., Editors. A Text-Book of X-Ray Diagnosis by British Authors in Four Volumes. Second edition. H. K. Lewis & Co., Ltd., London, 1950.
12. TRETTER. Articulatio talo-calcanea. *Röntgenpraxis*, 1942, *14*, 431.

Vol. 76, No. 6

BENIGN OSTEOPETROSIS

REPORT OF 9 CASES

By ARNOLD D. PIATT, M.D., GERALD A. ERHARD, M.D., *and* JACOB S. ARAJ, M.D.
NEWARK, OHIO

OSTEOPETROSIS is an uncommon disease of unknown etiology. Some of the appellations given to this disease are Albers-Schönberg disease, marble bone disease, chalky bone disease, and osteosclerosis fragilis generalisata. Karshner[11] designated the entity as osteopetrosis in 1926, and it has become the term most widely used. To our knowledge, more than 200 cases have been reported in the medical literature since the disease was first described by Albers-Schönberg[1] in 1904, although undoubtedly many cases have not been published. Osteopetrosis, better known in infants and children because of its more frequent occurrence in this age group, usually follows a malignant course with fatal termination, according to Pugh.[18] However, the disease has been reported in youngsters and adults[5,6,17,20,21] where it was encountered coincidentally during roentgen examination for some other condition. In this group, the disease is often asymptomatic and assumes a "benign" form. It is to this latter category that we have confined our report.

The incidence of the disease is relatively rare showing no racial or sex preference. It has been found in all age groups, having beeen reported in utero[10] and in elderly individuals.

The etiology of osteopetrosis is unknown but several possibilities have been suggested. A hereditary factor has been shown in some of the cases since several members of the same family possessed the disease. McPeak[15] reported 8 cases of osteopetrosis in 3 generations of one family and Kelley and Lawlah[12] found 4 cases in the third generation of a family. Three of our cases are from the same family with a maternal uncle known to have the disease. The hereditary theory has been supported to some degree by studies made in rabbits in which hereditary osteopetrosis was demonstrated by Pearce[16] in 293 instances. Fluorine ingestion was considered by Speder[22] and Bishop[2] because of the roentgenographic similarity of the osseous changes in fluorine poisoning to those of osteopetrosis. The histologic studies, however, are not similar and show that these are distinct and separate entities. Karshner[11] found a pituitary adenoma in one case of osteopetrosis, but this was apparently incidental since no similar tumors have been reported in any other autopsied cases.

HISTOPATHOLOGIC ASPECTS

A review of the literature reveals that the histopathologic studies are primarily from the childhood form of the disease in which autopsies were performed in a relatively few cases.[7,8,13,14,23] The findings vary with the stage of the disease at the time of death. Pugh[18] concisely describes the pertinent features and refers to the excellent work of Weinmann and Sicher.[23] The essential pathologic change is sclerosis of bone with increased trabeculation and irregular bony architecture. There is hypercalcification of cartilage with a persistence of the calcified cartilage. The marrow space is markedly decreased or obliterated in advanced cases. Any residual marrow is of a myeloid type with evidence of fibrosis rather than lipoid deposition. The osteoblasts are increased in number while the osteoclasts are either diminished or absent. Perivascular lymphocytic infiltration is noted. A marked loss of the fibrils of the bone is seen which is especially noticeable in the cortex.

There is some difference of opinion as to the pathologic physiology in osteopetrosis. Zawisch-Ossenitz[24] believes that osteopetrosis is a disease due to unknown influ-

ences which damage the bone-forming blastema at the beginning of the second period of development of each individual bone when the inner layers of the cortex are being resorbed from within to widen the marrow cavity. From this period, differentiation is retarded, especially in absorption of calcified cartilage and spongiosa. Cohen,[8] after a complete autopsy on a thirty-two month old girl, concluded that the generalized bone lesions in osteopetrosis are abnormalities in remodeling sequences leading to the absence of the marrow cavity and retarded resorption of calcified cartilage, with formation of a conical chondro-osseous complex.

The osseous lesions in osteopetrosis are the primary morphologic changes in the disease. The other findings, on autopsy, are mainly manifestations of extramedullary hematopoiesis involving the liver, spleen, and lymph nodes.

CLINICAL MANIFESTATIONS

Subjective symptoms were absent in over half of our cases and the disease was discovered by accident following a roentgen examination for some other reason. In the remainder of the cases except one, symptoms were of minimal character. The one case had debilitating findings which were significant.

The signs and symptoms of osteopetrosis are the result of morbid changes in the osseous system, hence, they vary according to the degree of involvement. The childhood form of the disease, as described in the literature, is usually characterized by one or several of the following manifestations.

1. Multiple fractures are frequently found that occur with a minimal amount of trauma. These fractures are probably due to fragility of bone caused by the lack of mature lamellar bone and a high ratio of the inorganic matter to the organic.
2. The encroachment upon the medullary canal usually produces an extramedullary hematopoiesis with the resulting hepatosplenomegaly and generalized lymph node involvement.
3. Anemia, which is also induced by a similar process, is usually severe and of the hypochromic type.
4. Where the disease involves the skull, there is noted a thickening of the base of the skull with encroachment on the foramina resulting in cranial nerve impairment. Often deafness and optic nerve atrophy prevail.
5. Occasionally hydrocephalus may occur.
6. A pronounced dental caries is a frequent finding.

It was of interest to note that an elevated blood serum calcium was found in several of our cases, which is contrary to the usual normal figures that most investigators report.

ROENTGEN FINDINGS

The disease may be detected at birth,[7] or the bones may appear normal at birth with evidence of osteosclerosis appearing later in life.[9] Caffey,[4] in his excellent text, qualifies much of the roentgen pathology of osteopetrosis in infants and children. The roentgen findings vary with the severity and extent of the disease. The following are the most common pathologic changes seen.

The long bones show a homogeneous chalky density with a lack of differentiation between the cortex and the medullary cavity. Frequently noted are transverse and longitudinal striations at the metaphysial ends of the bones. Also at the metaphysial ends, clubbing is observed with a loss of modeling. The nutrient foramina are either narrowed or obliterated which is particularly evident in the long bones. Coxa vara and genu valgum deformities often exist.

The bones of the skull, when involved, demonstrate a similar homogeneous pottery type of density with loss of the diploic spaces between the tables of the skull. There is no apparent increase, however, in the over-all dimensions of the skull. Thickening of the base of the skull is

prominent with encroachment upon the cranial nerve foramina. If involvement of the facial bones occurs, the paranasal sinuses appear narrowed or partially effaced.

The iliac bones of the pelvis show alternating dense and translucent zones parallel to the iliac crests resembling growth rings in a tree. At times these curvilinear stripings are not present but instead the chalky, somewhat homogeneous type of sclerosis exists.

Changes occur in the vertebrae which are quite striking in appearance. The upper and lower portions of a body show plate-like condensations with a translucent zone bisecting the body horizontally. A wedge-shaped area of diminished density is observed on the anterior aspect of the body in the midthird from which the translucent zone extends posteriorly. Occasionally, a central core of bone density is seen in the center of the translucent zone which resembles a neonatal vertebral body and is termed an "insert." The appearance of the entire vertebra is believed to be due to a persistence of infantile characteristics (vascular channels and intersegmental fissure). In the more advanced cases and in older patients, the vertebrae may be involved with a uniform chalky sclerosis similar in appearance to that observed in the long bones. The ribs may show the "marbleized" process as well as an appearance of widening.

The carpal and tarsal bones exhibit rather unusual concentric rings of dense and clear bone. Brailsford[3] believes this finding occurs when the bones, which are normal at birth, later have periods of osteosclerosis followed by intervals of remissions and growth.

REPORT OF CASES

Case 1. G. V., a thirty-two year old woman, was admitted to the hospital for a roentgen examination of her right foot because of an injury. The roentgenogram of the foot revealed "a fracture of the promontory of the os calcis. There were also noted in most of the tarsal

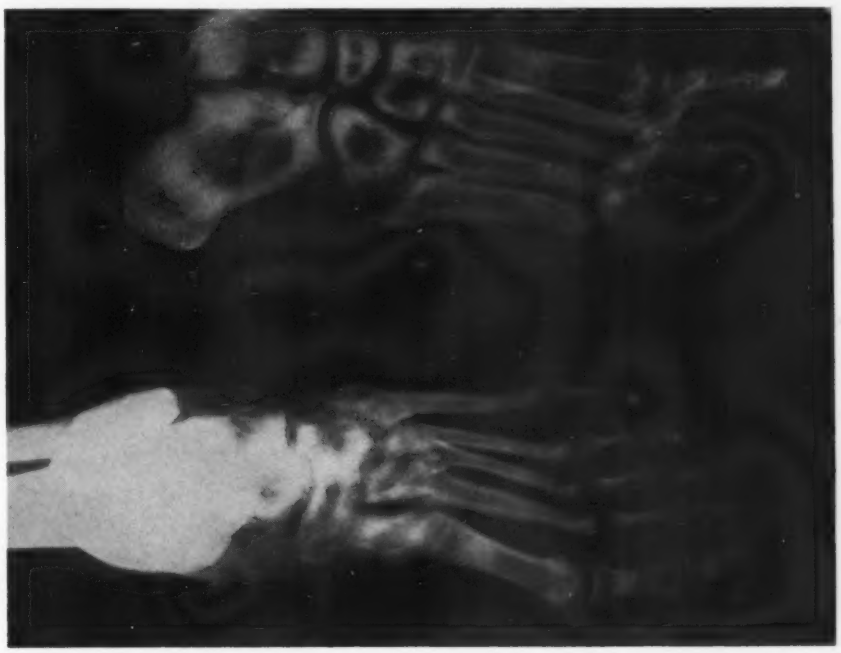


Fig. 1. Case 1. The concentric rings of sclerosis in the tarsal bones with central areas of normal appearing bone exemplify the bouts of exacerbations and remissions with normal bone growth. The metatarsals and phalanges show varying degrees of involvement with transverse striations evident, especially in the hallux. Note the fracture of the calcaneal promontory.

bones concentric rings of osteosclerosis alternating with zones of translucency" (Fig. 1). On questioning the patient, she stated that three years prior she had a skeletal roentgen survey because of a suspected bone abnormality. The patient was informed at that time that she had a condition known as "marble bones." No history of previous fractures was obtained nor did any known members of the family suffer from the entity, osteopetrosis. The patient was married, but had no children.

Physical examination revealed no positive findings except for a genu valgum deformity and evidence of injury to the right foot. Laboratory procedures, which included blood cell counts with differentials and hemoglobin determinations, blood chemistries of inorganic phosphorus, serum alkaline and acid phosphatases, blood urea nitrogen and urinalysis, were all normal. The only abnormal finding was an elevated blood serum calcium of 13.6 mg. per 100 cc.

The roentgenograms made several years previously were obtained and showed involvement of the dorsal and lumbar vertebrae and ribs (Fig. 2), pelvis and femora (Fig. 3 and 4), tibiae and fibulae, tarsal bones and phalanges of the feet.

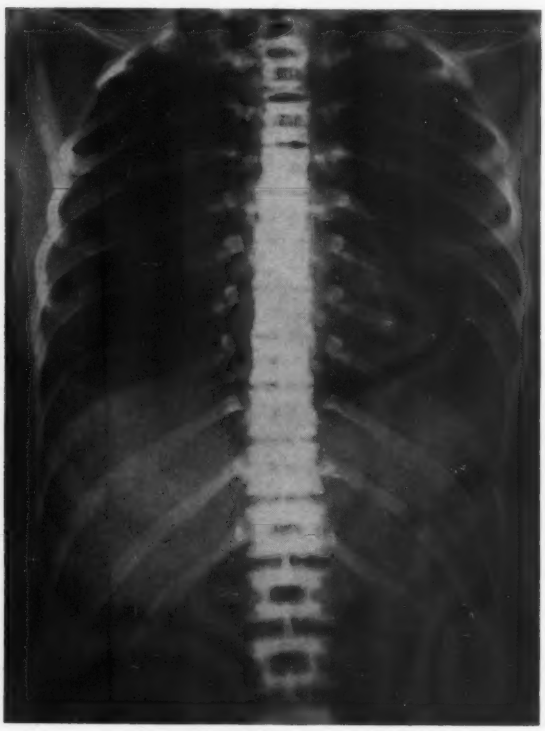


FIG. 2. Case 1. The dorsal and lumbar vertebrae reveal the plate-like condensations at the superior and inferior aspects of the bodies with a central zone of translucency indicative of infantile characteristics. The ribs appear broadened and "marbleized."

FIG. 3. Case 1. The arc-like striations in the ilia resemble growth rings in a tree. Observe the pseudoepiphyses over the crests of the ilia.

CASE II. H. S., a sixteen year old high school girl, because of the complaint of persistent pain in the left lower quadrant of the abdomen, was sent to the hospital by her physician for roentgen studies of the gastrointestinal and urinary tracts. During these examinations, it was noted that she had some sclerotic process involving the vertebrae and pelvis (Fig. 5). Additional skeletal roentgenograms demonstrated invasion of the ribs, femora, tibiae and fibulae (Fig. 6). No unusual pertinent information was offered by the patient, nor did she at any time suffer any fracture. The patient is one of 8 siblings who are living and well. Roentgen examination of the osseous systems of the father, mother, and 2 of the available siblings showed no bony abnormalities. No known member of the family was felt to have shown any of the clinical manifestations of the osteosclerotic disease.

There were no abnormalities found on physical examination of the girl. The laboratory studies performed, which were within normal limits, consisted of complete blood counts, nonprotein nitrogen, serum phosphatases, and

Fig. 4. Case I. Note the extensive sclerosis at the ends of the long bones with a tendency for clubbing at the distal end of the femur. Modeling has been altered.

urinalysis. The blood serum calcium was elevated and found to be 13.6 mg. per 100 cc.

Case III. J. H., a seventeen year old boy, was admitted to the hospital following a fall from a ten foot high swing. Roentgenograms were taken of the left forearm and the left hip which revealed fractures of the left radius and the left femoral neck. An abnormal sclerotic process was discovered in the pelvis and upper femora (Fig. 7). Additional roentgenograms of the osseous system showed the diseased process in the skull, dorsal and lumbar vertebrae, radii and ulnae, femora (Fig. 8), tibiae and fibulae, carpal bones and phalanges of the hands. On physical examination, the patient revealed evidence of the fractured extremities as well as a marked dental caries. There were no other positive findings. He had been reasonably well all of his life except for the usual childhood diseases. No other fractures had been incurred until the present ones. On investigation into the family history, it was learned that a maternal uncle was known to have "marble bones." A skeletal survey of the entire family, consisting of the mother and 5 brothers of the patient, was instituted by us and demonstrated the disease in the mother and one brother.

The laboratory data showed no abnormal blood changes or chemistries except for an elevation of the blood serum calcium which was 13.5 mg. per 100 cc. The urinalysis was normal.

A hip-pinning operation was performed on the patient and the surgeon stated that the bone was very hard and that the marrow cavity seemed nonexistent. A metal tool was broken during the introduction of the Smith-Peterson nail.

Case IV. E. H., aged forty, mother of J. H. reported in the preceding case, was discovered

Fig. 5. Case II. The vertebral bodies show dense bands traversing the upper and lower margins with normal appearing bone between the bands. Patchy condensations are seen in the pelvis. Contrast medium in the kidneys is visualized from intravenous pyelography. Barium can be noted in the cecal area from a colon study.

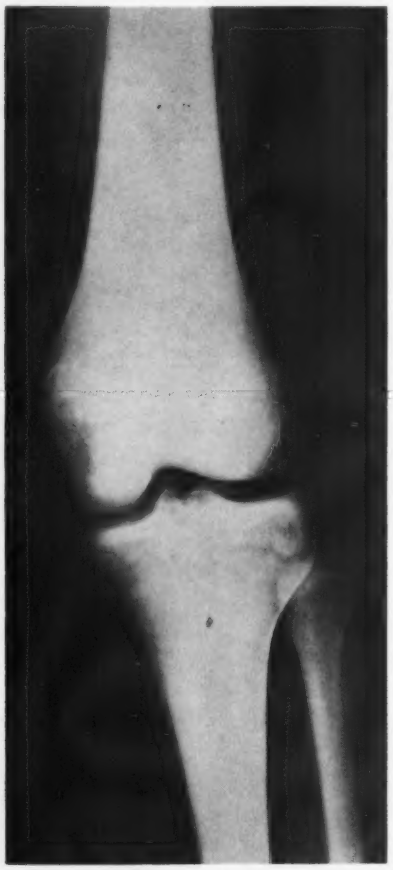


FIG. 6. Case II. Note the homogeneous sclerosis and the loss of the medullary cavity in the long bones. There has been no influence on modeling.

FIG. 7. Case III. The fracture of the left femoral neck is obvious. The pelvis and the proximal ends of the femora present a uniform pottery type of sclerosis with partial obliteration of the medullary spaces in the upper femora.

FIG. 8. Case III. The dense opacification of the femur is one of the predominant findings in osteopetrosis. The femur has a flail-like appearance with almost a complete disappearance of the medullary cavity. The nutrient foramina seem to be effaced.

to have the disease during the skeletal survey of the family and was entirely symptomless. She had had 6 pregnancies and 6 normal deliveries and all of the children were living and seemingly well. Her brother is a known case of osteopetrosis. Her roentgen examination showed involvement of the skull (Fig. 9), dorsal and lumbar vertebrae (Fig. 10), pelvis, femora (Fig. 11), tibiae and fibulae, tarsal bones and phalanges of the feet.

The physical examination was essentially negative. The laboratory procedures, which included complete blood studies and chemistries, were normal except for an elevated blood serum calcium of 13.25 mg. per 100 cc.

CASE V. S. H., the six year old son of E. H. in the preceding case and the brother of J. H. in Case III, had no symptoms referable to osteo-

Fig. 9. Case iv. The thickening and density at the base of the skull is striking. The calvarium shows a homogeneous condensation with a loss of the diploic structure. The size of the skull does not appear to be increased.

petrosis. There was no history of any fractures ever having been incurred. His roentgen examination during the family survey revealed the pathologic process in the skull, dorsal and lumbar vertebrae (Fig. 12), ribs, pelvis and femora.

No physical abnormalities were found in the patient on clinical examination. Blood counts and chemistries were normal except for an elevation of the blood serum calcium which was 11.35 mg. per 100 cc.

Case vi. R. B., a ten year old Negro boy, was admitted to Children's Hospital in Cincinnati, Ohio, in January of 1953. Three months prior to admission, he injured his hip while playing football. Since that time he had pain localized to the right hip and he limped on walking.

Physical examination on admission was normal except for the right lower extremity which was one eighth inch shorter than the left. There was also some limitation of rotation of the right leg and thigh. The laboratory studies which included complete blood counts and chemistries were normal.

Roentgenograms re-

Fig. 11. Case iv. The femur shows the typical appearance found in the long bones of osteopetrosis featuring obliteration of the marrow space and nutrient foramina, clubbing, and diffuse chalky sclerosis. Modeling at the distal end of the femur has been effected.

Fig. 10. Case iv. The bodies of the vertebrae present wedge-shaped translucent notches anteriorly from which extend horizontal central zones of diminished density and this phenomenon is attributed to the persistence of infantile traits (vascular channels and intersegmental fissures). Note the bony central nidi in the bodies which suggest neonatal vertebral bodies, termed "inserts."

FIG. 12. Case V. The changes in the vertebral bodies are not as pronounced as in some of the other cases; however, there are typical appearances of the disease present.

vealed early slipping of the right femoral capital epiphysis with an increased density of the bony structures. The skull and chest films (Fig. 13) also showed an increased thickness and over-mineralization of all of the osseous components.

A biopsy taken from the right femoral neck and capital epiphysis proved the tissue material to be consistent with an osteosclerosis of the Albers-Schönberg disease.

CASE VII. E. G., a forty-four year old white male, was admitted to Dunham Hospital in Cincinnati during the month of May, 1948,

FIG. 13. Case VI. The broadened ribs and ground-glass opacity of the bony structure are common findings in benign osteopetrosis.

with the diagnoses of active pulmonary tuberculosis, amyloidosis, and osteopetrosis. A mandibulectomy had been performed some time previously for a condition which was thought to be actinomycosis. The family history was not significant. Two siblings were living and well.

The patient was a poorly developed, emaciated individual appearing chronically ill. The

FIG. 14. Case VII. The active tuberculosis in the right upper lobe is quite evident. The ribs demonstrate the apparent widening and chalky type of infiltration.

Fig. 15. Case VIII. Sclerosis at the base of the skull and involving the mastoids and petrous ridges as well as the sphenoids can be observed. The sphenoidal sinuses appear to be obliterated.

positive physical findings were an absence of the mandible, a tumor of the palate, and an ankylosis of the right hip. The laboratory studies included sputum examinations which

Fig. 16. Case VIII. The involvement of the upper extremity presents a variable degree of homogeneous sclerosis. The medullary canal of the humerus is almost effaced. Note that the nutrient foramina cannot be visualized. Transverse lines of density are found in the metacarpals and phalanges.

Fig. 17. Case VIII. The pelvis and upper femora show varying aspects of the disease. Striations are found in the ilia with chalky depositions in the acetabular regions and in the upper femora. Note the residuum of the old fracture of the right femur with absorption of the head and neck and a varus deformity.

were positive for tubercle bacilli, blood counts which were essentially normal except for a hypochromic anemia and urinalyses reported within normal limits. No blood chemistry determinations had been performed.

The roentgenograms showed involvement of the dorsal and lumbar vertebrae, ribs (Fig. 14), humeri, pelvis and femora.

Case VIII. T. L. B., a twenty-one year old white male, was first observed twelve years previously when a diagnosis of osteopetrosis with bilateral cataracts, optic atrophy and dental caries was made. The deciduous teeth were quite premature and dental caries appeared at the age of eighteen months. Permanent teeth began to erupt at the age of four and decay occurred rapidly thereafter. He had had "bad eyes" since infancy and an impairment in hearing on the right side was found at an early age. An osteomyelitis of the mandible, secondary to a dental infection from extraction, occurred at the age of ten years, necessitating surgical removal of the mandible one year later. During this period of hospitalization, several blood transfusions were required due to a pronounced anemia. In that same year, he sustained a fracture of the right femur. For the past five years, he has been in relatively good

FIG. 18. Case VIII. Transverse lines of condensation appear in the proximal and distal ends of the tibiae and fibulae. Sclerosis about the knee joint is more marked than in the remaining osseous structures.

health; however, he suffered a fractured rib a year ago. One sibling is living and well. No history of additional cases in the family was obtained.

At the time of the last examination he was 57¾ inches tall, weighed 112 pounds and had an "Andy Gump" appearance. Positive physical findings included exophthalmos, deafness in the right ear, nystagmus, cataract of the left eye, optic atrophy of the right eye, an edentulous maxilla, absence of the mandible and a faint systolic murmur at the base of the heart. The laboratory data were within normall imits.

The roentgenograms of the osseous system revealed invasion in the skull (Fig. 15), dorsal and lumbar vertebrae, clavicles, ribs, humeri, radii and ulnae (Fig. 16), phalanges of the hands, pelvis (Fig. 17), femora, tibiae and fibulae (Fig. 18) and the tarsal bones.

CASE IX. M. C., a forty year old white female, was seen in an out-of-town hospital for an anemia. No further details were available and it was impossible to obtain any further information or data concerning this patient. A final diagnosis of osteopetrosis was made in the hospital. The films were loaned to us to be included in our series. The roentgen findings are rather conclusively those consistent with osteopetrosis (Fig. 19 and Fig. 20).

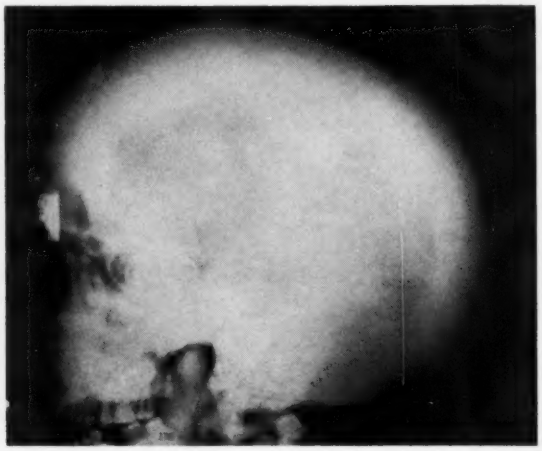


FIG. 19. Case IX. The pagetoid appearance of the skull strongly simulates the "woolly" aspects of osteitis deformans. The markedly thickened tables show a homogeneous chalky invasion. The accessory nasal sinuses seem to be partially obliterated. The skull size does not seem to be increased.

DIFFERENTIAL DIAGNOSIS

In establishing the diagnosis of the benign type of osteopetrosis, several other

FIG. 20. Case IX. The generalized diseased process involves the pelvic bones and the upper femora with a loss of the architectural pattern of the bones.

conditions must be ruled out. These are Paget's disease of bone (osteitis deformans), fluorosis of bone (fluorine intoxication), metastatic bone lesions, osteomyelofibrosis associated with anemia or leukemia, Garré's sclerosing osteomyelitis, chronic osteomyelitis, syphilitic osteoperiostitis, hyperparathyroidism, tuberous sclerosis, leontiasis ossea and melorrheostosis. We will briefly mention the pertinent differential points in each entity.

The sclerosing type of Paget's disease produces a uniform increase in density of bone with obliteration of the trabecular detail which may resemble osteopetrosis. Occasionally there is a mosaic appearance of the pathologic bone. An over-all enlargement of the diameter of the involved bone is noted which is not observed in the Albers-Schönberg disease. When osseous surveys are made, some of the bones involved in the osteitis deformans show coarsening of the cortical lamellae prior to the sclerosis. Deformities are frequently encountered in Paget's disease which are not of the character of those seen in osteopetrosis. An elevated alkaline phosphatase is found in Paget's disease and this does not occur in marble bones.

Fluorosis of bone (fluorine intoxication) is sometimes difficult to differentiate from osteopetrosis during some stages of the development of the condition. In this disease, the cortical trabeculations become coarse and thickened with an increasing diminution in definition of the structure. This gives the appearance of bone deposition about the trabeculae. Gradually there is a generalized increase in osseus density with irregular spicules or proliferations extending outward from the periosteum at the site of muscular attachments. There is a massive appearance to the involved bone. These findings are first noted in the spine and pelvis. In osteopetrosis, the bones are usually more dense than observed in fluorosis but do not show any particular enlargement, nor do spicules develop at the site of muscle insertions. A bone biopsy showing the presence of fluorine crystals is conclusive proof of the entity, fluorosis.

Metastatic lesions from carcinoma of the prostate and occasionally of the breast, or of the upper gastrointestinal tract, sometimes present a differential problem. Clinical data referable to malignancy are important. Bone pain is a frequent complaint which may initiate the original roentgen examination. A high serum acid phosphatase is indicative of a carcinoma of the prostate with osseous metastases. The osteoblastic metaplasia resulting from metastatic neoplasm does not have the uniform chalky appearance that exists in osteopetrosis.

Osteomyelofibrosis associated with anemia or leukemia is often extremely difficult to differentiate since calcium is laid down in the cancellous portion of the bone obliterating the medullary canal. As in osteopetrosis, the outward form of the bone is unchanged. The bony pattern reveals an unusual stippling which is somewhat characteristic. The skull is rarely involved. Sternal marrow biopsy contributes to clarify the diagnosis. The blood findings and concomitant clinical data of anemia or leukemia aid in the differentiation.

In a diffuse chronic osteomyelitis or the Garré's sclerosing form of osteomyelitis, the history of a chronic inflammatory process as well as the localized character of the involvement rules out any confusion with marble bones. Syphilitic osteoperiostitis sometimes resembles osteopetrosis by producing a marked sclerosis and thickening of the affected bone; however, the new bone formation is usually irregular and laid down parallel to the shaft of the bone. There is also an absence of the pottery type of deposition seen in osteopetrosis. A positive serologic test aids in confirming the diagnosis.

Several other entities are mentioned, namely, hyperparathyroidism, tuberous sclerosis, leontiasis ossea, and melorrheostosis, because of some localized manifestation which may be confused with osteo-

petrosis. Osteoporosis and cystic changes are the predominating lesions in hyperparathyroidism while osteosclerosis is the chief manifestation of osteopetrosis. Tuberous sclerosis shows sectional areas of sclerosis which involves chiefly the cranium; however, destruction and osteoporosis may coexist producing a mixed lesion. The familial neurocutaneous syndrome is quite prevalent in this disease. Periosteal changes are also observed in the tarsal bones and phalanges in tuberous sclerosis as well as zones of osteoporosis and necrosis. Leontiasis ossea must be ruled out when the facial bones and skull are involved. Considered as a form of fibrous dysplasia with osteomatoid thickening of the base of the skull and facial bones, other manifestations may be present, such as Albright's syndrome, thinning of the cortex from within and expansion of the affected bone, especially the long bones which tend to show an abnormal elongation. Pseudocystic formations of lesions occur which are fairly well circumscribed and, when fractures are sustained, they heal rather rapidly. Melorrheostosis may simulate on occasion marble bones; however, the condition shows an irregular deposition of dense bone along the periphery strongly suggesting candle drippings. The diameter of the bone is increased, with the axial distribution presenting the picture of osteoperiostitis. Most often the bones of one limb are affected.

SUMMARY

In summary, benign osteopetrosis is a bone condition compatible with reasonably normal living and may be asymptomatic or mildly symptomatic. The clinical and roentgenographic manifestations have been presented and the differentiation from other resembling entities has been made. Nine cases are reported.

Arnold D. Piatt, M.D.
36 West Locust Street
Newark, Ohio

A grateful acknowledgment to Dr. Fred Silverman, Children's Hospital, Cincinnati, Ohio; Dr. Ben Felson, Cincinnati General Hospital, Cincinnati, Ohio; Dr. Jacob Weinberger, Holzer Hospital, Gallipolis, Ohio, and Dr. Paul Francke, St. Francis Hospital, Charleston, West Va., is made for allowing us to publish their cases in our series. The enthusiasm of Dr. Ben Felson stimulated the presentation of this article.

REFERENCES

1. ALBERS-SCHÖNBERG, H. Röntgenbilder einer seltenen Knochenerkrankung. Aerztlicher Verein in Hamburg, Sitzung vom 9 Feb., 1904. *München. Med. Wchnschr.*, 1904, *51*, 365.
2. BISHOP, P. A. Bone changes in chronic fluorine intoxication. AM. J. ROENTGENOL. & RAD. THERAPY, 1936, *35*, 577–584.
3. BRAILSFORD, J. F. Sclerosing conditions of bone. *Brit. J. Radiol.*, 1950, *23*, 83–91.
4. CAFFEY, J. Pediatric X-Ray Diagnosis. Year Book Publishers, Inc., Chicago, 1945, pp. 49, 595, 798.
5. CALLENDER, G. W., and MIYAKAWA, G. Osteopetrosis in adult. *J. Bone & Joint Surg.*, 1954, *35*, 204–210.
6. CASSIDY, W., and others. Osteopetrosis. *Arch. Int. Med.*, 1948, *82*, 140–158.
7. CLIFTON, W. M. Osteopetrosis. *Am. J. Dis. Child.*, 1938, *56*, 1020.
8. COHEN, N. Osteopetrosis. *J. Bone & Joint Surg.*, 1951, *33*, 923–938.
9. FAIRBANKS, H. A. Osteopetrosis. *J. Bone & Joint Surg.*, 1948, *30-B*, 339–357.
10. JENKINSON, E. L., and others. Prenatal diagnosis of osteopetrosis. AM. J. ROENTGENOL. & RAD. THERAPY, 1943, *49*, 455–462.
11. KARSHNER, R. G. Osteopetrosis. AM. J. ROENTGENOL. & RAD. THERAPY, 1926, *16*, 405–419.
12. KELLEY, C. H., and LAWLAH, J. W. Albers-Schönberg disease; family survey. *Radiology*, 1946, *47*, 507–513.
13. KNEAL, K., and SANTE, L. R. Osteopetrosis (marble bones). *Am. J. Dis. Child.*, 1951, *81*, 693–707.
14. MCCUNE, D. J., and BRADLEY, C. Osteopetrosis (marble bones) in an infant. *Am. J. Dis. Child.*, 1934, *48*, 949–1000.
15. MCPEAK, C. N. Osteopetrosis. Report of eight cases occurring in three generations of one family. AM. J. ROENTGENOL. & RAD. THERAPY, 1936, *36*, 816–829.
16. PEARCE, L. Hereditary osteopetrosis in rabbits. AM. J. ROENTGENOL. & RAD. THERAPY, 1949, *61*, 354–365.
17. PLOTZ, M., and CHAKALES, H. J. Osteopetrosis.

New York State J. Med., 1953, *53*, 445–447.

18. Pugh, D. G. The Roentgenologic Diagnosis of Disease of Bone. In: Nelson's Loose-Leaf, Diagnostic Roentgenology. Editor, R. Golden, Williams & Wilkins Company, Baltimore, pp. 2, 444–446, 484.
19. Rosenthal, N., and Erf, L. E. Clinical observations on osteopetrosis and myelofibrosis. *Arch. Int. Med.*, 1943, *71*, 793–813.
20. Rugg-Gunn, M. A. Case of marble bone disease. *J. Roy. Nav. M. Serv.*, 1947, *33*, 312–315.
21. Seigman, E. L., and Kilby, W. L. Osteopetrosis; report of case and review of recent literature. Am. J. Roentgenol. & Rad. Therapy, 1950, *63*, 865–874.
22. Speder. Generalized osteopetrosis (Marmorskelett) is not a rare disease! Its frequency in fluorine intoxication. *J. de radiol. et d'électrol.*, 1936, *20*, 1–10. (Abstr. Year Book of Radiology, 1937, p. 79.)
23. Weinmann and Sicher. Cited by Pugh, D. G.[18]
24. Zawisch-Ossenitz, C. Marble bone disease; study of osteogenesis. *Arch. Path.*, 1947, *43*, 55–75.

BENIGN CHONDROBLASTOMA OF BONE

ITS ROENTGEN DIAGNOSIS*

By ROBERT S. SHERMAN, M.D., *and* ALI REHA UZEL, M.D.
NEW YORK, NEW YORK

THIS rare primary tumor of bone has been a sufficient source of diagnostic error in this radiologic department to stimulate us to look into the subject to see if we could not uncover information that would improve our results in the future. In reviewing the scanty literature on this lesion, it was at once apparent that except for the presentation of Codman there was little detailed information of basic help to the diagnostic roentgenologist, and some that was even misleading. This state of affairs is easy to understand when it is realized that the discussion of roentgen diagnosis was handled at times by those not specially oriented in this field. Codman's description of the roentgen appearance of this tumor, though accurate and informative for his own material, is today not sufficiently broad and thorough because it was limited to chondroblastomas occurring in the humeral head. The purpose of this study, therefore, is to present in a detailed manner the points of value in the roentgen diagnosis of benign chondroblastoma of bone based upon a review of 11 cases histologically proved.

Chondroblastoma of bone was not reliably identified until about twenty-five years ago. Previously the lesion had been variously diagnosed by pathologists as chondrosarcoma, osteogenic sarcoma, giant cell tumor, and so forth. Ewing[5] suspected this lesion to be a specific kind of tumor when in 1928 he tended to set it aside from regular benign giant cell tumor of bone by referring to it as "calcifying giant cell tumor." It remained for Codman[2] to establish the tumor as an entity when two years later he presented a group of 9 of these new growths located at the humeral head in the greater tuberosity area. He coined the name "chondromatous giant cell tumor." He still considered the tumor to be an unusual variation of benign giant cell tumor and his concept of the process was also further restricted by the belief that it was limited to the area of the proximal epiphysis of the humerous and that it was related to the age when the epiphysis was uniting. The next important contribution after Codman's was in 1942 when Jaffe and Lichtenstein[6] showed that the main tumor cell was of cartilage origin. They also demonstrated that "benign chondroblastoma," the term they recommended for this neoplasm, could be found in various other bones than the humeral head. Finally, in 1949 Copeland and Geschickter[4] pointed out that a malignant variety of benign chondroblastoma may occur. We are told that one such case is present in the Pathology Laboratory files of Memorial Center. We are also informed that such a lesion might at times be diagnosed pathologically as chondrosarcoma, osteogenic sarcoma, or even benign chondroblastoma.[1]

Age and Sex Incidence. The sex incidence in this group of patients is almost evenly distributed, 5 of them being males and 6 females. Six of Codman's 9 cases were males and all of Jaffe and Lichtenstein's 9 cases were males. Apparently this tumor can be seen in both sexes but is expected to be more frequent in males.

Age range is more widely spread in this series than is the case with Codman's and Jaffe and Lichtenstein's material. The patients in this series varied from nine to thirty-five years of age. While it seems clear that chondroblastoma can be found in childhood as well as in adult age after complete closure of the epiphysial line,

* From the Department of X-ray Diagnosis, Memorial Center, New York, New York.

Fig. 1. Case 1. A thirteen year old male had noticed gradual enlargement of the left thumb for six months prior to admission. On physical examination there was marked increase in size of the terminal phalanx of the left thumb with the thumb nail also broadened. The tumor mass was tender. Roentgenologic impression was giant cell tumor, osteochondroma or osteochondrosarcoma. Alkaline phosphatase was 26.8. The thumb was amputated through the mid-portion of the proximal phalanx. Patient has been well eighteen years.

the majority of the cases will be found during adolescence as the epiphysial lines are closing. In our cases the following bones were involved: femur, 4; humerus, 3; tibia, 1; talus, 1; metatarsal, 1; and phalanx, 1.

Location in Bone. There were 4 tumors located at the knee in the condylar region of the femur. Two were contained in the epiphysial area. One, while mainly in the epiphysis, showed some extension across the plate into the metaphysis with the last tumor being equally located in epiphysis and metaphysis.

Three tumors were in the humerus and 2 of these were in the epiphysis of the humeral head. While 1 was confined to the head alone, the other involved a small part of the neck as well. The third case cannot be juged in this aspect as the original pretreatment films were not seen by us (Case XI).

The other chondroblastomas were rather atypical as to location. One in the proximal metaphysis of the tibia was very unusual in that it was confined to the metaphysis and spared the epiphysis, although it was in contact with the epiphysial plate. Another tumor destroyed the terminal phalanx of the left thumb with the disease extending into the epiphysial area at the base of the phalanx. The final tumor involved a portion of the astragalus.

Clinical Features. There are apparently no clinical features that would permit an examiner to make a specific diagnosis of chondroblastoma. The two symptoms common to most bone tumors, *viz.*, pain and swelling, were usually reported as being present in varying degrees. Signs of limitation of joint motion, limp, swelling and tenderness have also been noted. As far as we can determine from the hospital charts no one identified the true nature of the patient's disease before roentgenographic studies were made. Laboratory determinations of blood calcium, phosphorus and alkaline phosphatase levels do not appear to be specific or even suggestive of the diagnosis.

Final diagnosis in these tumors for the purpose of the present study was arrived at histologically by a review of the slides by Dr. Arthur Allen of the Pathology Laboratories, with the exception of Case XI which was confirmed by Dr. Fred Stewart. Most of these tumors upon review had their original label confirmed, but in two instances a revision of an earlier pathology report was necessary.

Roentgen Appearance. The epiphysial relationship of chondroblastoma has been stressed, particularly by Codman. The present material shows that considerable variability in the location of the tumor to the epiphysis is possible. In some of these

FIG. 2. Case II. (*A* and *B*) A thirteen year old female developed persistent pain at the medial aspect of the knee six months prior to admission. The pain was aggravated by weight bearing and walking. On physical examination there was slight tenderness over the medial condyle of the left femur but no other findings. The roentgen impression was chondroma or chondroblastoma (*A*). Blood chemistries were normal. Patient was treated by curettage and bone chips with good results (*B*). She has been well seven years.

tumors the epiphysis was found to be closed and in others it remained open. One aspect of the relationship seems constant, however, and that is that the lesion is always found to be at least in contact with or touching the epiphysial line. There were but 3 cases in which the tumor was confined within the epiphysis. In another the metaphysis held the entire process with contact with the epiphysial line being present only superiorly. Five of the lesions showed varying amounts of involvement of both epiphysis and metaphysis. The talus lesion has not been included in this discussion of epiphysial relationship.

All tumors were evidently of medullary origin, being largely or wholely contained within the bone.

There was not much variation in the size of the chondroblastomas. The smallest was 2.0 by 2.0 by 2.5 cm. and the largest measured 6.5 by 7.5 by 5.2 cm. Most were 2.5 to 3.0 cm. in diameter. The shape of the tumors was also fairly constant, being most often spherical or nearly so. As regards symmetrical location in the bone, 7 were asymmetrically and 3 were symmetrically placed. All cases revealed medullary bone destruction of a complete degree. All showed a very slight amount of productive change in the form of a few tiny flecks or strands. The internal pattern, therefore, consisted merely of a lytic background within which were a few tiny calcific flecks or strands forming a few incomplete and faint septa. Only one (Case VIII) presented fairly dense and complete septa and because of this it was considered to be somewhat atypical. The boundary of most of the tumors was fairly distinct except, of

course, along that part of the margin next to any soft tissue tumor extension. The cortex in the area of the tumor showed various effects, being destroyed in 1, expanded to some degree in 4 and having a combination of effects, *viz.*, destruction, expansion, and thinning in 3. In 2 of the neoplasms no cortical change occurred. One might not ordinarily expect periosteal activity with a benign tumor, but 4 did show such a reaction. Three were of the small buttress type emphasized by Codman, and 1 was of the parallel form. Only 1 tumor, that of the phalanx, extended to the joint. No frank evidence of synovitis was seen but in 2 instances the condition was suspected roentgenographically. There were 6 tumors showing some degree of soft tissue swelling. Some seemed merely to be due to edema, but some were clearly a small tumor mass. No pathologic fractures were seen.

There was no follow-up coverage after the original roentgenograms in 4 cases. One chondroblastoma shown roentgenographically covering a sixteen month period revealed no apparent change. The other 5 were followed from one to seven months, and these revealed a slight increase in size in all, the development of a periosteal reaction in 2, and slight productive changes occurring in another.

Only one (Case xi) had roentgenograms available to us that were taken after roentgen treatment. The original roentgen appearance is not clearly stated so that this case has been omitted from most of the preceding evaluation of the roentgen

Fig. 3. Case iii. A nine year old female complained of pain and swelling at the upper end of the right leg for six months prior to admission. On examination there was a tender fusiform swelling at the upper end of the right tibia 8 by 6 cm. in size. There were no skin or joint changes. There was some muscle atrophy of the right leg and slight edema at the anterior aspect of the tibia. Roentgenologic impression was Codman's tumor. Blood studies were normal. Curettage and bone transplant were done and patient has been well seven years.

FIG. 4. Case IV. A sixteen year old female noticed pain and swelling at the medial side of the right ankle for nine months prior to admission. Infrared treatments and a cast had caused no improvement. On examination a diffuse swelling at the medial aspect of the ankle at the medial malleolus was noted. A hard mass was palpated but could not be localized. Roentgenologic impression was giant cell tumor of the right astragalus. Blood chemistries were normal except for slight elevation of the blood calcium. The astragalus was curetted and patient has been well eight and one-half years.

appearance based on the untreated original tumor, but study of the post-therapy films was possible and a fairly dense area of scar bone seemed to be present. Those treated surgically, usually by curettage and chip insertion, showed as a late result a dense irregular scarring of bone with distinct margins. No patient had a skeletal survey. It is of passing interest that 4 patients did show one or more developmental cortical defects, usually in the distal femur.

A brief history of Case XI is presented here.

REPORT OF A CASE

CASE XI. (Courtesy of Dr. Donald W. Penner.) A sixteen year old female injured her shoulder and for two years thereafter complained of pain for which she received numerous chiropractic treatments without relief. A roentgen examination at that time was reported as negative though later review of these films suggested an ill-defined area of rarefaction in the humeral head. In the following three years

FIG. 5. Case V. A thirteen year old female complained of constant pain and swelling over the inner side of the left knee for one year. This had gradually increased with limitation of motion. She had been treated by application of a cast without improvement. On physical examination there was limitation of motion at the knee joint with synovitis and swelling over the inner aspect of the lower end of the femur. There were no skin changes but the knee was tender to palpation and there was atrophy of thigh and calf muscles. Roentgenologic impression was tuberculosis or malignant tumor. Blood chemistries were normal. Treatment was by curettage and bone chips. Patient has been well three years.

the pain continued and the shoulder was especially painful to palpation. A roentgenogram at this time revealed striking changes at the shoulder with an area of irregular rarefaction in the humeral head. At operation a rather hemorrhagic tumor was found occupying the head of the humerus. This was curetted almost completely. A pathologist reported the tissue as "osteogenic sarcoma—very malignant." Because of the long history and the roentgen appearance, the surgeon refused to amputate. The patient was, therefore, irradiated through two ports for a tumor dose of 4,000 r. Three years later her only complaint was a slightly stiff right shoulder. Roentgenograms reviewed by us were taken several months after irradiation. These showed an area of calcification and scar bone in the humeral head. Sections were reviewed by Dr. Penner and Dr. Fred Stewart and a diagnosis of chondroblastoma was made.

Fig. 6. Case vi. A fifteen year old male developed pain in the right shoulder nine months prior to admission. Pain was intermittent with exacerbations and remissions. A roentgenogram taken three months after the onset was said to be negative. On examination there was vague fullness of the right shoulder with point tenderness over the anterior aspect of the head of the humerus. Abduction past 90° produced pain. The roentgenologic impression was chondroblastoma, tuberculosis to be ruled out. Alkaline phosphatase was 7. Other blood chemistry studies were normal. Following curettage of the humeral head patient has been well fifteen months.

Fig. 7. Case vii. This twenty-one year old male complained of pain and disability of the right shoulder for twelve years following trauma. He was treated symptomatically without relief. Finally, roentgenograms were taken which showed a lesion of the head of the humerus which was interpreted as giant cell tumor. On examination there was marked atrophy of the shoulder girdle with limitation and pain on motion. There was no local heat or swelling but there was tenderness. Biopsy was done and patient received roentgen therapy, 3,500 r tumor dose in twelve days. There was no follow-up.

In brief, chondroblastoma presents in the roentgenograms as a rather small lesion having a constant relationship to the epiphysial plate usually being located more in the epiphysial than the metaphysial area. It is most often seen in the femur, humerus and tibia, but may be found in small bones

FIG. 8. Case VIII. This thirty-five year old male sustained a trauma to the left knee two years prior to admission. A roentgenogram at that time by his company physician was reported as demonstrating a giant cell tumor. A dull pain had continued over the area. On physical examination there was no deformity or limitation of motion. There was tenderness at the anterior aspect of the medial condyle with local increase of heat. Roentgenologic impression was chondroma, giant cell tumor or Codman's tumor. Blood calcium was 11.1. Other studies were normal. Treatment was curettage and patient has remained well eight years.

of the hand or foot. It shows an area of complete bone destruction with fairly distinct margins, spherical in shape and containing a few tiny linear flecks or shreds of calcification. The cortex may be slightly expanded, thinned or destroyed, and a soft tissue mass may be found. Periosteal reaction, particularly of a buttress type, may occur. Response to proper treatment is evidenced by the formation of scar bone, distinct margins, and loss of soft tissue mass and periosteal reaction if present previously.

FIG. 9. Case IX. A twenty-eight year old female noted swelling of the dorsum of her left foot following a sprain ten months previously. Swelling persisted and a roentgenogram showed a lesion of the 5th metatarsal. A biopsy elsewhere was reported as giant cell tumor. Examination showed swelling of the dorsum of the left foot with no limitation of motion. Roentgenologic impression was giant cell tumor, malignant tumor to be ruled out. Alkaline phosphatase was 7. Patient is awaiting treatment, but in the two month interval the lesion has increased five times in size.

Differential Diagnosis. The commonest error in roentgen diagnosis was in calling some of these tumors benign giant cell tumor. When it is realized that a few of

Fig. 10. Case x. (Courtesy of Dr. Raymond W. Lewis.) A seventeen and one-half year old male complained of pain over the left knee for two months. The pain was localized over the medial femoral condyle but there was no swelling or inflammation. Open biopsy was done and a soft crumbling tissue, grayish yellow in color, was found over an area 2.5 by 1.5 cm. The tissue diagnosis was confirmed by Dr. James Ewing as "cartilaginous variant of giant cell tumor." The patient made an uneventful recovery. Last follow-up was seven months after operation.

these cases had been labeled originally as giant cell tumor pathologically, the roentgenographic error is understandable because the roentgenologist's diagnosis in rare and obscure bone lesions is tied to and largely dependent upon the handling of such lesions by the pathologist with whom he is associated. Generally speaking, there should be little likelihood of confusing chondrobastoma with the typical benign giant cell tumor which has sharp margins, expanded but intact cortex, lytic effect with regular, well developed, intact septa and larger size. However, there apparently may be a rare benign giant cell tumor of bone that bears a close resemblance to chondroblastoma roentgenographically. The pathologic diagnosis of giant cell tumor lesions has shown some variability in this institution in the past decade. Because of this and because of the fact that as yet we have made no specific study of this primary bone tumor, we believe that any further attempt by us to differentiate between the two tumors is not indicated at this time.

A few chondroblastomas in this series have been seriously considered as being malignant tumors, either metastasis from cancer or a lytic form of osteogenic sarcoma. As to the former, the patient's age, the absence of a primary tumor and the singleness of the lesion as well as its epiphysial relationship would ordinarily all serve to direct the roentgenologist away from a diagnosis of metastatic cancer. The possibility of an osteolytic osteogenic sarcoma would be more difficult to exclude. However, the spherical shape, the epiphysial location, the presence of any degree of cortical thinning and expansion, and the fairly distinct borders of the lesion are all more apt to be seen in chondroblastoma. Perhaps the small size of the lesion itself is of special help because rarely are osteogenic sarcomas seen in the large bones to be as small as this tumor. The paucity of the periosteal reaction, the absence of the perpendicular form and the relative smallness of the soft tissue mass are also against an osteogenic sarcoma. The fine detritus in the tumor would tend to exclude myeloma as would the location, singleness of the lesion, and age of the patient.

Enchondroma was a diagnosis offered once or twice in this series but the calcific shreds, the cortical destruction, the soft tissue mass, and the occasional periosteal reaction are not to be expected in enchondroma. Also the location near or in an epiphysis and the presence of a single lesion

in a large pipe bone speak against this diagnosis.

In two instances of chondroblastoma occurring at the knee in the femur, a diagnosis of bone tuberculosis was entertained initially. This was done before it was realized that a certain amount of periosteal reaction can occur in chondroblastoma. Also in each of these lesions some synovitis was suspected. However, the absence of dependable evidence of synovitis, the lack of decalcification at the joint, the failure to note any joint changes or cartilage destruction should have been real clues against the diagnosis of tuberculosis. Other infections would tend to be excluded more or less on similar grounds.

SUMMARY AND CONCLUSION

1. Eleven histologically proved benign chondrobastomas of bone have been studied roentgenologically.

2. This tumor generally presents a fairly characteristic appearance in the roentgenogram, although atypical forms do exist at times.

3. Important points in roentgen diagnosis are the age, epiphysial relationship, lytic background with fine calcific shreds, small size and occasional periosteal reaction.

Robert S. Sherman, M.D.
444 East 68th Street
New York 21, New York

REFERENCES

1. ALLEN, A. C. Personal communication.
2. CODMAN, E. A. Epiphyseal chondromatous giant cell tumor of upper end of humerus. *Surg., Gynec. & Obst.*, 1931, *52*, 543–548.
3. COLEY, B. L., and SANTORO, A. J. Benign central cartilaginous tumors of bone. *Surgery*, 1947, *22*, 411–423.
4. COPELAND, M. M., and GESCHICKTER, C. F. Chondroblastic tumors of bone; benign and malignant. *Ann. Surg.*, 1949, *129*, 724–735.
5. EWING, J. Classification and treatment of bone sarcoma. In: International Cancer Conference. Report of International Cancer Conference, London, 1928. John Wright & Sons, Ltd., Bristol, 1929, pp. 365–376.
6. JAFFE, H. L., and LICHTENSTEIN, L. Benign chondroblastoma of bone. *Am. J. Path.*, 1942, *18*, 969–991.
7. LICHTENSTEIN, L., and KAPLAN, L. Benign chondroblastoma of bone; unusual localization in femoral capital epiphysis. *Cancer*, 1949, *2*, 793–798.

Vol. 76, No. 6

OSTEITIS CONDENSANS ILII*

By JOSEPHINE WELLS, M.D.
NEW YORK, NEW YORK

THE term osteitis condensans ilii is used to describe a fairly uniform triangular area of increased density in the lower portion of the iliac bone, adjacent, to, but not involving, the sacroiliac joint (Fig. 1). It may be unilateral or bilateral.

The purpose of this paper is to report on 67 cases of this condition which were collected in reading routine roentgenograms at the Presbyterian Hospital in New York City.

Osteitis condensans ilii has received considerable attention since the article of Hare and Haggart in 1945,[4] in which they state that it was first described by Sicard, Galley and Hagenau in 1926. There have been very few biopsies. Shipp and Haggart[6] reported one which on microscopic study showed "trabeculations which were increased in density with scattered islands of cartilage suggesting a low-grade ischemic process." Gillespie and Lloyd-Roberts[3] described hard bone with a quantitative increase. Rendich and Shapiro[5] reported a biopsy from a thirty-six year old man who had back pain. This showed condensation of bone and an unusual number of myocytic and plasma type cells. The roentgenograms in this case suggested Marie-Strümpell arthritis.

FIG. 1. Osteitis condensans ilii, bilateral.

Theories as to the etiology of osteitis condensans ilii are varied. Rendich and Shapiro[5] raised the point that a nutrient foramen occurs in that part of the ilium adjacent to the inferior portion of the sacroiliac joint. Shipp and Haggart[6] suggested that since osteitis condensans ilii is generally seen in women, mostly post partum, motion or strain associated with pregnancy may be a factor. The sacroiliac joint is an amphiarthrosis, the articular surfaces being separated by cartilage. In the young adult the surfaces are close; later they are separated by fluid. In the weight-bearing position, the sacrum is displaced forward into the pelvis. The interosseous and posterior sacroiliac ligaments resist this tendency. In some women the sacroiliac joint lies in the sagittal rather than the oblique plane. In pregnancy the ligaments relax and the strain increases. The articular portion of the ilium resists the thrust of the sacrum as it rotates forward. Szabados[7] described 5 cases of osteitis condensans ilii; 3 were associated with active urinary infection, and in 2 cases there was a history of previous urinary infection. He postulated that there may be some alteration in the circulation of the iliac bone due to infection of the ureters; these lie in close apposition to the nutrient foramen of the iliac bone. The prevalence in females is accounted for by the prevalence of pyelitis in females.

Borak[1] in 1946 put forward the theory that osteitis condensans ilii was a precursor of Marie-Strümpell arthritis. He presented a case which had osteitis condensans ilii and four years later showed a loss of the sclerosis with decalcification and evidence of Marie-Strümpell arthritis. The illustrations shown are not very clear.

* From the Department of Radiology of the College of Physicians and Surgeons, Columbia University, and the Radiological Service of the Presbyterian Hospital, New York, New York.

Fig. 2. Marie-Strümpell arthritis. Note irregularity of joints.

The sclerosis of the iliac bone in Marie-Strümpell arthritis is quite irregular, and there is always evidence of disease of the sacroiliac joints (Fig. 2).

Gillespie and Lloyd-Roberts[3] found no specific clinical picture in a series of 21 cases. All their patients had symptoms, and were studied primarily because of back pain.

In the past few years in reading routine roentgenograms at the Presbyterian Hospital in the City of New York, the author has collected 67 cases which meet the criteria of osteitis condensans ilii. Evidence of this condition was in the majority of cases detected on films taken for reasons other than back symptoms, *e.g.*, gastrointestinal studies, intravenous pyelograms, abdominal films, pelvimetries, etc. Only about one-third of the patients had films taken specifically of the low back. None of these patients at any time under observation had evidence of disease of the sacroiliac joint. Some patients have been followed as long as six years.

All of the 67 patients were adult females, from twenty-five to sixty-five years old. The majority were in the twenty-five to forty-five year range, similar to the Haggart series. Eighty per cent of them had had children. Slightly less than one-half of them were described as obese. Eight or about 12 per cent had evidence of urinary infection. Thirty or less than one-half of them had low back pain. There did not seem to be any relation between obesity and symptoms. Nineteen of the 67 patients were Negroes. Twenty-one showed unilateral involvement, 46 bilateral. The pubis showed irregular sclerosis in only a few cases. It must be pointed out, however, that the pubis was not demonstrated in all cases.

Several of these cases had roentgenograms taken over a four to six year period with no evidence of change. There were no cases in which the sclerotic area diminished in size or density. In a woman of twenty-six years of age there was only a slight sclerosis noted on pelvimetry films in 1946 during her first pregnancy, but there was a definite osteitis condensans ilii three years later.

Report of a Case

A thirty-five year old female (Chart No. 47,398) complained of severe attacks of low back pain for twenty years. The onset was insidious. In the past year she had pain most of the time. The pain was aggravated by activity, lifting, bending and coughing. She has not been relieved by heat, massage, corset or bed rest. Her symptoms worsened after pregnancies eight and eleven years ago.

On physical examination she was thin. Her back showed a slight lumbar list to the right; there was no apparent spasm. She was tender to the right in the region of the sacroiliac joint. The roentgenograms showed osteitis condensans ilii bilaterally. On February 13, 1952, a bilateral sacroiliac fusion was done. The surgeon's report was that the sacroiliac joint on the right was narrow but motion was demonstrable; on the left no motion was demonstrable. The bone chips on section were described by Dr. Garber as follows: "All the sections show interlacing trabeculae of bone and those of the right side in particular are rather wide. In Sections A and B there is some irregularity of the cement lines but this is not marked enough for serious consideration of Paget's disease. Bone marrow of sections A and B is fatty. In the marrow of Section A (right ilium), surrounded by a very thin zone of fibrous tissue, there is a moderate sized round area of intensely basophilic, almost homogeneous amorphous material which is probably calcium salt. As this is seen in several serial sections, it is probably not an artefact. At a

margin of the section not far away from this point there is some attached hyaline cartilage like that of joint cartilage, although the joint margin is not actually included. This cartilage is a little irregular in architecture and some of it stains poorly as though degenerated. In another section taken from the right side, probably tissue B, bone on one side is bordered by a very irregular, partly fibrillated layer of hyaline cartilage exhibiting some large areas of irregularity of architecture and necrosis. Some of the necrotic cartilage is replaced by immature hyaline cartilage and this newly formed cartilage extends into underlying region of eroded bone and partly surrounds some spicules of necrotic bone. Bone marrow adjacent contains a considerable number of eosinophils and also a higher concentration of small round cells than is to be found elsewhere in the section.

"In one section from the left sacral region, bone is bordered on one side by hyaline cartilage of rather irregular architecture and a few of the cartilage cells are degenerated. The section does not include a sharp articular margin. One small area of fibrotic bone marrow is noted. Although no round amorphous mass of calcium salt is seen in this section as in Section A, there are a few scattered bits of similar material which possibly fractured when the section was cut. In two other sections from sacrum, marrow is similar and trabeculae are not remarkable. Diagnosis: Degenerative arthritis with some adjacent resorption of bone, cartilage repair, fibrosis, slight chronic inflammation of adjacent bone marrow, some generalized irregularity in architecture of bone, and presence of a few small round amorphous calcific deposits in bone marrow (region of sacroiliac joint, right). The changes are suggestive of a reaction to mechanical injury. Slight irregularity in architecture of bone and probable degenerative arthritis (sacroiliac region, left). Note: The subchondral changes in the tissue from the right side are suggestive of reaction to mechanical injury."

When asked to review the sections regarding the question of osteitis condensans, Dr. Garber stated: "I can say that the picture is probably consistent with osteitis condensans. Sacrum is involved more than ilium in our case, which is apparently unusual but not unknown in osteitis condensans. We received three pieces of sacrum and only one piece of ilium."

Follow-up note on January 5, 1953 states "the patient is still having pain but less than before." The last films on October 31, 1952 showed that the sacroiliac joints were still open.

DISCUSSION

In this series of 67 cases of osteitis condensans ilii, previous pregnancy was present in 80 per cent. No evidence of a connection between this lesion and Marie-Strümpell arthritis was demonstrated. The incidence of urinary infections and obesity seems too low to be significant.

Since less than one-half of these patients had low back symptoms, the significance of osteitis condensans ilii in relation to pain seems questionable. In the low back clinic at this hospital[2] the commonest cause of lumbar pain was muscular unbalance occurring in post partum women. Osteitis condensans, therefore, occurs in a group particularly prone to low back pain for other reasons.

SUMMARY

Sixty-seven cases of osteitis condensans ilii were studied. Less than one-half of them had low back pain.

The Presbyterian Hospital
622 West 168th Street
New York 32, New York

REFERENCES

1. Borak, J. Significance of sacroiliac findings in Marie-Strümpell's spondylitis. *Radiology*, 1946, *47*, 128–141.
2. Gaston, S. Personal communication.
3. Gillespie, H. W., and Lloyd-Roberts, G. Osteitis condensans. *Brit. J. Radiol.*, 1953, *26*, 16–21.
4. Hare, H. F., and Haggart, G. E. Osteitis condensans ilii. *J.A.M.A.*, 1945, *128*, 723–727.
5. Rendich, R. A., and Shapiro, A. V. Osteitis condensans ilii. *J. Bone & Joint Surg.*, 1936, *18*, 899–908.
6. Shipp, F. L., and Haggart, G. E. Further experience in management of osteitis condensans ilii. *J. Bone & Joint Surg.*, 1950, *32-A*, 841–847.
7. Szabados, M. C. Osteitis condensans ilii; report of three cases associated with urinary infection. *J. Florida M. A.*, 1947, *34*, 95–99.

FRACTURE OF THE HYOID BONE*

PRESENTATION OF ONE CASE

By MAXWELL H. POPPEL, M.D., *and* ROBERT O. CHRISTMAN, M.D.
NEW YORK, NEW YORK

THE roentgenologic finding of a fracture of the hyoid bone is still a rather rare occurrence. In the past twenty years there have been but 7 reports in the medical literature. In this case, magnification technique was used to reveal the extent of the fracture.

The hyoid bone has five segments, a body, two greater and two lesser cornua. It is shaped like a horseshoe and is suspended from the tips of the styloid processes of the temporal bones by the stylohyoid ligaments. Occasionally, anomalies of the hyoid bone occur, with the appearance of four, instead of two greater cornua, probably due to ossification of the stylohyoid ligaments. The ossified ligaments may be completely fused with the hyoid bone, or may articulate with it.

In the early months of uterine life the hyoid bone is represented by hyaline cartilage which is directly continuous with the styloid process of the temporal bone. Ossification occurs from six centers. The two which give rise to the lateral parts of the body (basihyal) and the two centers for the greater cornua (thyrohyals) are derived from the third branchial arch and appear at birth or shortly after. The two centers for the lesser cornua (ceratohyals) are derived from the second branchial arch and appear later and more variably. The second branchial arch also gives rise to the stylohyoid ligament and the styloid process of the temporal bone.

According to Cunningham, in about fifty per cent of cases there is no osseous union between the corpus and the greater cornua of the hyoid bone and the actual incidence is thought to be somewhat higher. The lesser cornua are not constantly demonstrable. In fifty per cent they are separated from the corpus by cartilage. There is a true diarthrodial joint present which disappears only in old age. The lesser cornua are the points of attachment for the stylohyoid ligaments.

The stylohyoid ligament rarely ossifies, and, when it does so, the structure is called the epihyal bone. When the bone is small in size and occurs near the hyoid bone, it may be confused with the lesser cornu or with a fragment from a fractured hyoid bone.

The usual causes for fracture of the hyoid, in order of frequency, are (1) hanging or strangulation, (2) sudden trauma to the anterior or lateral aspect of the neck; and (3) violent muscular action, either in marked and rapid hyperextension of the neck, or more rarely, in deglutition.

FIG. 1. Lateral roentgenogram of the cervical spine. Careful scrutiny reveals a radiolucent linear defect in the greater cornu. This first aroused suspicion of a fracture.

* From the Departments of Radiology, Bellevue Hospital and the New York University College of Medicine, New York, New York.

REPORT OF A CASE

A. C., a sixteen year old white male, was admitted to the hospital in a coma about one-half hour after an automobile accident in which he went through the windshield of the car. He sustained multiple scalp and face lacerations and a fracture of the left radius. Upon admission to the Emergency Ward, skull and cervical spine roentgenograms were ordered. Because of coma and neurologic signs indicative of irritation to the left hemisphere, the patient was transferred to the Neurology Service. Two days after admission, his breathing became somewhat stridulous and a subcricoid tracheotomy was performed and closed four days later. The patient regained consciousness after three days and complained of mild dysphagia. He made a slow and uneventful recovery and was discharged two weeks after admission.

Upon examination of the lateral roentgenogram of the cervical spine, a hyoid fracture was suspected (Fig. 1). It was kept in mind that anomalies of the hyoid bone can often be confused with fractures and spot films of the area were ordered and taken. A definite fracture line was seen through the left greater cornu with interruption of the continuity of the cortex on the superior and inferior borders and downward displacement of the distal fragment (Fig. 2). Magnification studies revealed the fracture more clearly (Fig. 3) and ruled out an anomaly of the hyoid bone.

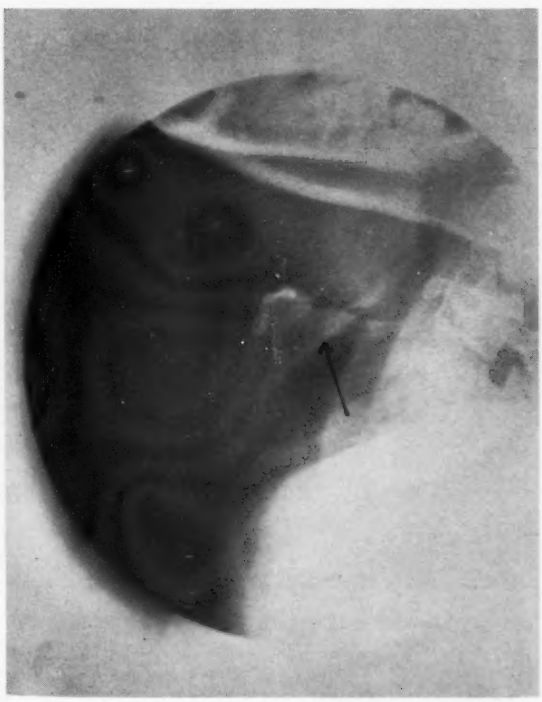


Fig. 2. Spot roentgenogram of the hyoid bone. The fracture line is evident with downward displacement of the distal fragment.

Fig. 3. Magnification technique. The fracture line is clearly demonstrated.

Maxwell H. Poppel, M.D.
Bellevue Hospital
550 First Avenue
New York 16, New York

REFERENCES

1. Becco, R. V., and Cini, C. Fracture of hyoid bone, trauma of larynx with report of case of fracture and luxation of hyoid bone. *Rev. argent. de oto-rino-laring.*, 1938, *7*, 3–12.
2. Castello, R. Frattura isolata dell'osso iodide; casa clinico. *Minerva otorinolaringologica*, 1954, *4*, 32–35.
3. Giuntoli, L. Fracture of hyoid bone in patient with anomaly of stylohyoid ligament. *Rassegna previd. sociale*, 1940, *27*, 74–76.
4. Guernsey, L. H. Fractures of hyoid bone. *J. Oral Surg.*, 1954, *12*, 241–246.
5. Kleinberg, S. Fracture of hyoid bone. *Ann. Surg.*, 1934, *99*, 547–548.
6. Olmstead, E. G. Fractures of hyoid bone; presentation of two cases with review of literature. *Arch. Otolaryng.*, 1949, *49*, 266–274.
7. Tomizuka, A. Hyoid bone fractures; two cases. *Otorhinolaryngology*, 1936, *9*, 418.

ROENTGENOLOGICALLY DEMONSTRATED MYELOMATOUS AREAS OF THE SKELETON PROVING TO BE DUE TO METASTASES FROM EPITHELIOMA*

By HANS H. BASSÖE
HAMMERFEST, NORWAY

GENERALIZED punched out areas found at roentgen examination of the skeletal system indicate the presence of multiple myeloma. The areas usually are localized in the skull, ribs and pelvis with lack of reaction from the surrounding osseous tissue. Similar roentgen findings may be observed in metastases from carcinoma of the breast. The metastases in such cases are described as being of a myelomatous type. In the following, a brief account is given of a case of generalized myelomatous metastases of the skeletal system secondary to a squamous epithelioma.

REPORT OF A CASE

The patient, a woman thirty years old, was admitted to the hospital on October 1, 1954. She had no previous history of disease. A routine roentgen examination of the chest in March, 1954 revealed no pathologic findings. This examination for some other reason was repeated twice. On admittance the patient was twenty-four weeks pregnant. About two months before the admittance she had suffered from distinct pains localized to the skull and neck. Soon after these pains had appeared, ischialgic pains also developed.

At the first examination she appeared to be in good health. No tumor could be palpated in the breasts. There was no general or local lymphadenopathy. She complained of aching in the musculature of the back, but there was no pain on percussion of the spinous processes. No positive findings could be ascertained.

Four days after the hospitalization the patient presented signs of rib fractures on the right side. She complained of severe pains,

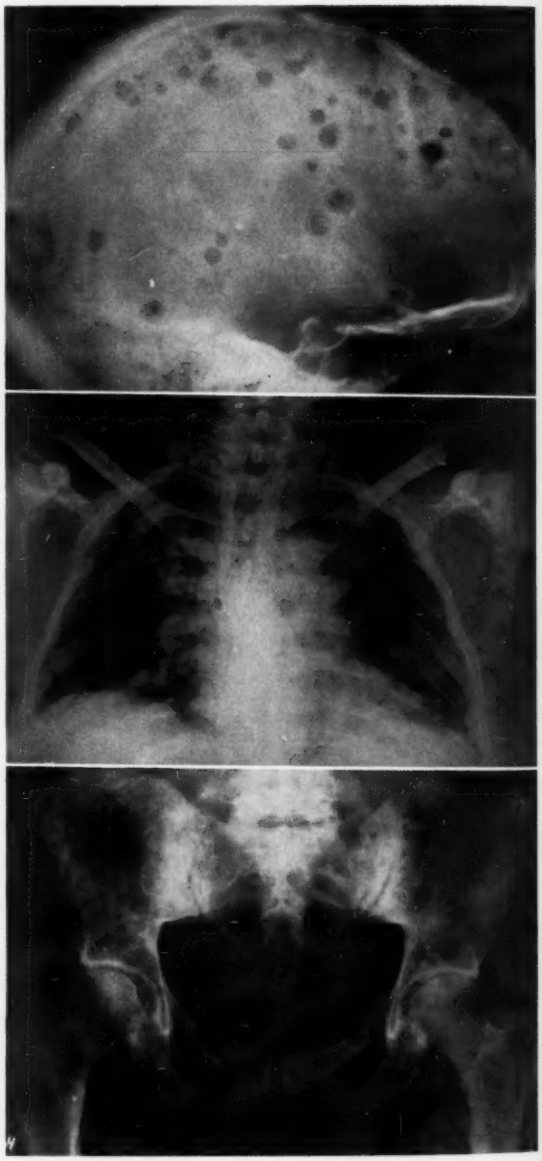


FIG. 1. Skeletal metastases of squamous epithelioma.

* From Hammerfest Sykehus, Medical Department, Chief: Hall Schartum-Hansen, Hammerfest, Norway.

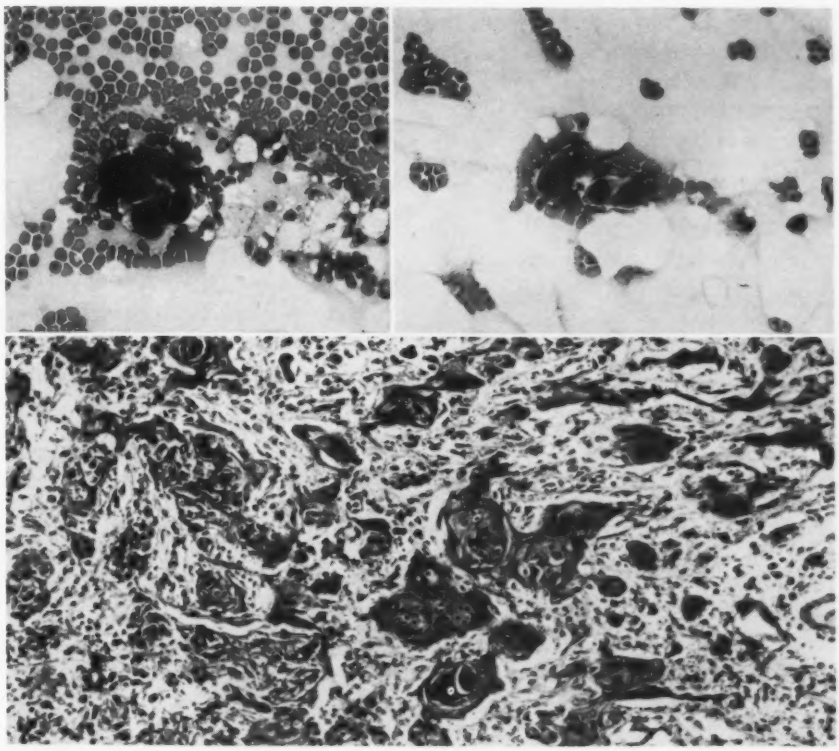


Fig. 2. Top: Cancer cells in a preparation from sternal puncture. Bottom: Metastases of squamous epithelioma localized to a rib.

especially in the back. The condition worsened rapidly. The pains seemed to be to some extent relieved following 100 mg. ACTH and 100 mg. cortisone. Generally, however, the condition was retrogressive. After a period of four weeks she developed unconsciousness, and died six weeks after the admittance.

Laboratory Findings. Urine: negative. Blood: hemoglobin values diminished from 78 to 62 per cent and rose again to 80 per cent following two blood transfusions. Sedimentation rate increased from 99 mm. to 135 mm. and thereafter decreased to 72 mm. Serum proteins were about 6 per cent, serum phosphates 3.9 mg. per cent and serum calcium 13.1 mg. per cent. Normal values of 17-keto-steroids (4.7 mg. per day).

Electrophoretic examinations of serum proteins:

albumin	35.0 per cent of T.P.	35.4 per cent of T.P.	55–65 per cent of T.P.
alpha 1 globulin	4.0	4.6	3–5
alpha 2 globulin		Normal	
beta globulin	32.0	29.0	10–13
gamma globulin	28.5	31.0	16–21

Cytologic examination of the sternal bone marrow (May-Grünewald-Giemsa) showed large cells of 25 to 30 microns in diameter of a type not usually seen in such preparations (Fig. 2). The nuclei were relatively large with a smooth, dotted appearance and 2 to 3 relatively large, oval, blue-stained nucleoli. The cells, despite the roentgen appearance of the bones, were considered to be cancer cells. Apart from these cells the bone marrow showed a normal picture with no signs of increase in the numer of plasmacellular elements (myelomatous cells).

Roentgen Findings. At the roentgen examination (Fig. 1) numerous small, sharply delimited punched out areas were found localized to the skull, clavicles, scapulae, ribs, spinous processes, ilia, sacral bone, humeri, right radius and both femora. The largest area measured

18 by 20 mm. There was no reaction from the surrounding osseous tissue. Similar, but less pronounced areas were seen in both tibiae and fibulae. There were fractures of several ribs. There were no signs of parenchymatous changes of the lungs apart from a prominent right hilus with a rather sharp lateral border.

Postmortem Findings. Unfortunately autopsy was refused, but two ribs were allowed to be removed for further examination. The normal osseous and cartilaginous tissues were in part replaced by a tumor tissue with numerous cells. These were agglomerated in smaller and larger groups, and were of irregular size and polygonal shape with a pronounced tendency to parakeratosis. The nuclei were sharp, vesicular or hyperchromatic, with wide variation in size. The tumor tissue was in part surrounded by a fibrous stroma (Fig. 2). Diagnosis: bone metastases from a squamous epithelioma (Kreyberg).

SUMMARY AND CONCLUSION

A six months pregnant woman, aged thirty, was admitted to the hospital because of severe pains in the skull and back. Death occurred in the hospital three and one-half months after the pains had first appeared. A roentgen examination of the chest eight months before death revealed no pathologic findings. During her stay in the hospital roentgenograms of the skeleton showed changes typical of multiple myeloma. An increase of serum globulins and a decrease of serum albumin were found. An examination of the sternal bone marrow showed cancer cells present. The postmortem histologic examination revealed bone metastases from a squamous epithelioma. No primary tumor nor any metastases to other systems than the skeletal were found.

Fagernes 3
Bishopshavn
Bergen, Norway

Vol. 76, No. 6

OSTEOMYELITIS VARIOLOSA

By ROBERT W. BERTCHER, M.D.

SPECIFIC involvement of bone in smallpox has been described pathologically, clinically and roentgenologically by many authors,[1–4] usually being termed osteomyelitis variolosa. A similar case, with recovery of the virus from affected bone, has been reported in vaccinia.[5] Most studies have been concerned principally with the late results of this bony involvement.

In the spring and summer of 1953, we were able to follow the early course of this aspect of variola in many children seen at the Maryknoll Sisters' Clinic in Korea, and examined roentgenologically at a United States Army Station hospital. In only 3 of the 6 cases seen were follow-up studies available. These 3, who were followed over a three to four month period, will be reported in some detail.

REPORT OF CASES

CASE I. This three year old boy developed the exanthem of variola at the end of April, 1953. On June 19, he was brought to the clinic with the history that he had been unable to stand since the exanthem had appeared. He had had swelling of the left knee, which had since subsided. Examination revealed swelling of the right knee, which was mildly painful on motion. The child was afebrile. The following day, roentgen studies of both knees were made (Fig. 1). The patient received no specific therapy for the knee involvement. During the following three and one half months, this child had measles and shigellosis, and was treated for hookworm infestation. At the end of this time, both knees were noted to be "large and lumpy," but the boy walked normally. Follow-up roentgen studies were then made (Fig. 2).

CASE II. The onset of variola was in the first week of June, 1953, in this three year old girl. About three weeks later the parents noted swelling and restriction of motion at each elbow, and swelling of the left knee with tenderness of it and the left leg. Seen in the clinic on June 30, the child was febrile, pale, and showed evidence of much recent weight loss. A desquamating exanthem of variola was noted. Swelling and restriction of motion were present at both elbows and the left knee. The joints did not appear inflamed, and were minimally tender, but the child resisted passive motion at each, and would not walk or stand. Aspiration of the right elbow obtained about 2 cc. of sero-sanguineous fluid which showed no acid-fast or other organisms on smear. Four days later, the child was afebrile. Roentgen studies of the elbows and knees were made then (Fig. 3), and again after an uneventful three months (Fig. 4), at which time she walked normally. Elbow flexion was slightly limited bilaterally. Treatment had consisted of vitamin supplements only.

CASE III. This three year old boy was first seen in the clinic on June 19, 1953. The onset of variola had been one month earlier. About ten days before the visit, the parents had noted that the boy would not stand, and that both elbows and the left knee were swollen. Examination showed a pale, peaked, afebrile

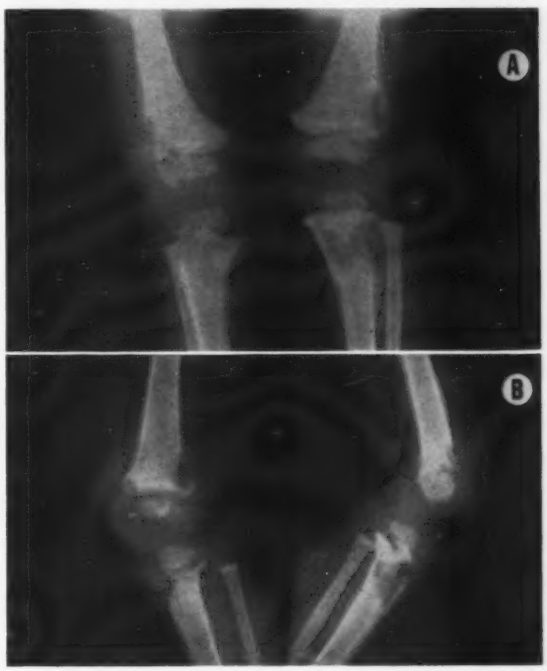


FIG. 1. (*A* and *B*) Anteroposterior and lateral roentgenograms of both knees in Case I, seven weeks after the onset of variola.

Fig. 2. Case 1. (*A* and *B*) Fifteen weeks after Figure 1. In addition to bony healing, the para-articular swelling has disappeared.

child with somewhat tender and moderately swollen elbows and left knee. Crusting lesions of variola were noted on the skin. The following day long arm casts and a left long leg cast were applied. On July 2, it was noted that the right knee and leg were also involved, and the child was sent for roentgen examination (Fig. 5). Additional therapy with vitamin, protein, and iron supplements was begun. All casts were removed after one month, during which time the patient was recovering from measles. The course for the next two months was uneventful. On September 29, good motion was noted at all joints, and the child was walking. On the following day, repeat roentgen studies were made (Fig. 6).

Of the 6 cases of osteomyelitis variolosa seen in this series, all were three years old, and one-half were boys. Fever was present in only 1 case when first seen; whenever fever did appear, a cause other than the bone and joint disease could be found. In 1 case the lower extremities alone were involved; in 2, only the upper extremities were affected; in 3, both upper and lower extremities were the site of pathology. In all cases involvement was symmetrical.

Osteomyelitis associated with variola may be the specific type reported above, or a suppurative type derived from hematogenous spread from pustular skin lesions. While the above 6 cases were under observation, 2 children were seen, each about three weeks after the onset of variola, with what was clinically diagnosed as acute, bacterial osteomyelitis. In neither case was roentgen examination made. When first seen, each child was febrile, the joints were acutely inflamed, and in 1 case, overlying abscess formation occurred. Both responded to treatment with antibiotics and sulfadiazine.

DISCUSSION

In all our cases, attention was first drawn to the elbow or knee. No other joint was involved in this series. Clinically, mild swelling of the para-articular soft tissues was usually noted. Although clinical findings suggested unilateral involvement in some cases, roentgen examination revealed bilaterally symmetrical disease in all instances. As a rule, all portions of a bone were affected, with destructive changes and numerous, irregular areas of bone resorption. Extensive periosteal new bone formation along the shafts—especially the paired tibia and fibula or radius and ulna—was noted.

The three month follow-up studies showed extensive bony regeneration in areas of previous destruction. Periosteal new bone was largely or completely resorbed in the remodeling process by which normal contours were restored to the diaphysis. In all cases, all joints were movable

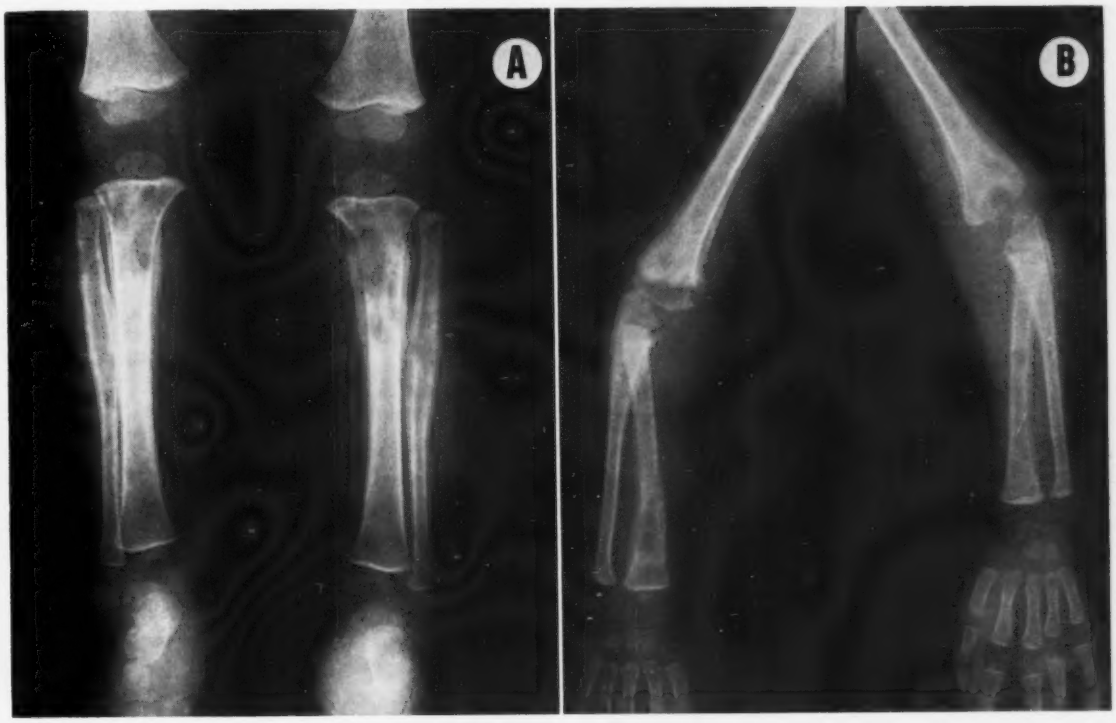


Fig. 3. Case II. (*A* and *B*) Symmetrical involvement of knees, elbows, legs, forearms and arms about one month after the onset of variola.

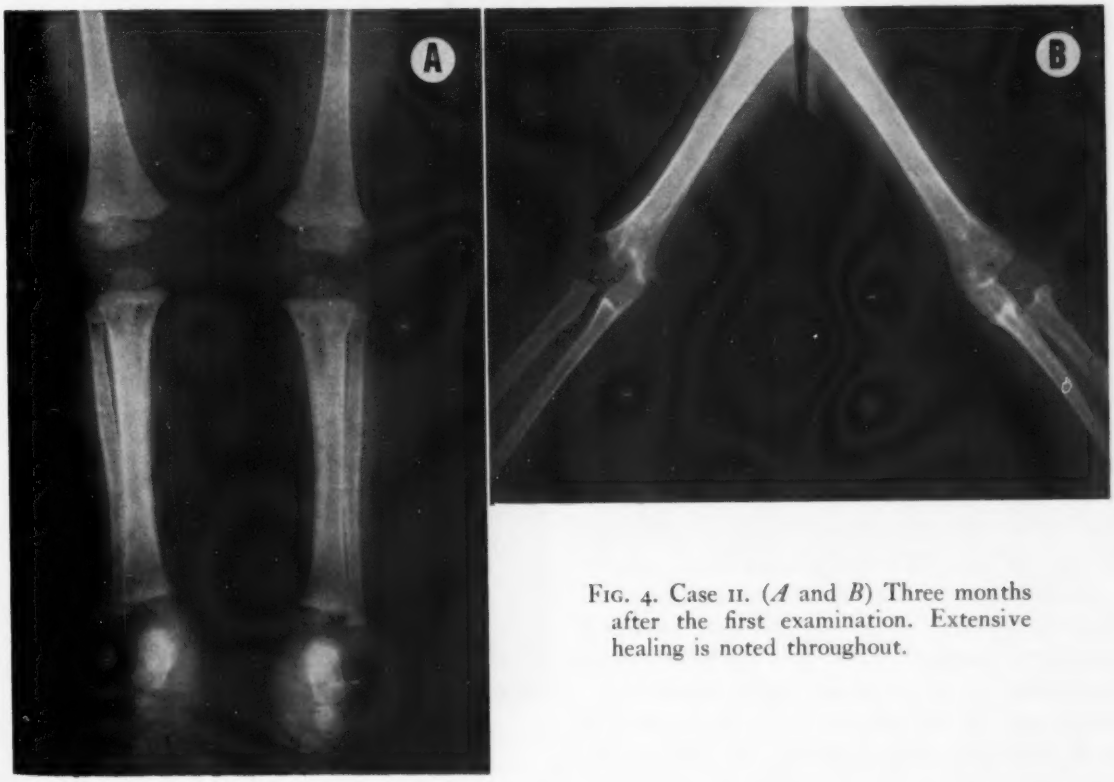


Fig. 4. Case II. (*A* and *B*) Three months after the first examination. Extensive healing is noted throughout.

FIG. 5. Case III. (*A* and *B*) One month after onset of variola, showing involvement of femur, tibia and fibula bilaterally.

through a wide range of motion at the time of the follow-up visit.

Healing occurred despite malnutrition and various intercurrent infectious diseases. In some cases, casts were applied to limit motion at an affected joint. It was hoped that in this way, permanent deformity could be avoided. In our cases, no conclusions as to the value of these casts could be drawn clinically or roentgenographically. Previous reports suggest that much of the eventual deformity results from epiphysial destruction and consequent uneven growth of paired bones. Our follow-up period was too short to demonstrate such deformity.

Specific bone disease of variola results most probably from invasion of bone at the time of initial viremia. Pathologically, early lesions in the bone marrow have been reported.[4] The cases in this series support this view, since at first examination, when extensive bone changes were noted roentgenographically, the children were afebrile and the joints showed only minor swelling and tenderness. It is probable that only when the child recovers sufficiently from the fever and exanthem of variola to attempt to move about that complaints or findings referable to the bones and joints appear.

The incidence of osteomyelitis variolosa is low, but reports vary widely as to the figure.[1–3] In our series, the 6 children were seen only with this unusual complication, not when the exanthem appeared. Thus we

FIG. 6. Case III. Three months after the first examination.

feel that in most cases no clinic visit was made because of variola in the absence of complications, and therefore, incidence figures in this series are worthless.

SUMMARY

A group of cases demonstrating early, specific involvement of bone in variola has been presented.

Distinctive clinical and roentgenological aspects of this osteomyelitis variolosa have been discussed.

195 N. Village Avenue
Rockville Centre, New York

Acknowledgment is given for the continued interest and encouragement of Col. George F. Peer, commanding officer of the Station Hospital in which part of this work was done.

REFERENCES

1. Brown, W. L., and Brown, C. P. Osteomyelitis variolosa. *J.A.M.A.*, 1923, *81*, 1414–1416.
2. Chatterjee, R. N. Incidence of arthritis in smallpox. *Indian M. Gaz.*, 1950, *85*, 49–54.
3. Kini, M. G., and Kesavaswamy, P. Role of small-pox in production of deformities by causing infection of bones and joints. *Antiseptic*, 1941, *38*, 169–176.
4. MacCallum, W. G. A Text-book of Pathology. W. B. Saunders Company, Philadelphia, 1942, p. 817.
5. Sewall, S. Vaccinia osteomyelitis. *Bull. Hosp. Joint Dis.*, 1949, *10*, 59–63.

CLINICAL SIGNIFICANCE OF THE SUPRACONDYLOID PROCESS OF THE HUMERUS

CASE REPORT

By NATHAN KRISS, M.D.
GENEVA, NEW YORK

THE supracondyloid (supracondylar, supra-epitrochlear, epicondylic) process of the humerus is a bony, beakshaped, downward projection of the anteromedial surface of the humerus, about 5 to 7 cm. above the medial epicondyle. The process varies in size from a few millimeters to a centimeter or more. It is *not an exostosis* but a developmental anomaly, or variation, which has received early attention from anatomists, zoologists and anthropologists.

W. L. Gruber[4] stressed in a monograph (1856) its phylogenetic features. It forms a bony foramen in many mammals and reptiles. D. J. Cunningham[3] reported a supracondyloid foramen in a stillborn child (1899). Testut[12] collected 22 anatomic cases (1889).

Clinical references comprising one or more cases have been appearing in the medical literature. Solieri[10] (1929), Mandruzzato[5] (1938), and Barnard and McCoy[1] (1946) made essential contributions by presenting cases with median nerve symptoms relieved by removal of the supracondyloid process.

Radiologic writing contains little about the subject. Caffey[2] is an exception as he presents substantial information on this subject in his book. The clinical significance of the supracondyloid process lies in its relative frequency (0.1 per cent colored-1 per cent white, Terry[11]) and its potential ability of producing median nerve symptoms. Other rare and less important complications arising from the fracture of the spur, or an overlying bursa (Mandruzzato,[5] Barnard and McCoy[1]) can be discounted.

The roentgenologist has a deciding role in establishing the diagnosis since the demonstration of the supracondyloid process in a patient with an *isolated* median nerve neuralgia furnishes very supportive evidence of its causative nature. Since it can be easily removed and the patient cured from intolerable pain and suffering, roentgen examination of the distal half of the humerus—including elbow—should be a routine procedure in these cases. The lateral and oblique view, with arm rotated about 20 degrees inward, are necessary to visualize the spur completely. The latter (oblique, profile) may be the only view demonstrating the supracondyloid process since its location on the anteromedial surface of the lower humerus is subject to

FIG. 1. Anteroposterior view. Supracondyloid process is not fully visualized, but the increased concavity of the medial contour distally to the spur is well seen.

certain variations. It is even advisable to take two oblique views, with different angles of rotation to avoid the possibility of failure to show the spur.

Median nerve compression at the wrist beneath the transverse carpal ligament (carpal groove syndrome—spontaneous, Colles fracture, dislocation of the lunate, Phalen,[9]) is to be considered in the differential diagnosis.

In our case the roentgenographic studies furnished the clue to the diagnosis.

REPORT OF A CASE

Our patient was a forty year old European woman physician without a previous pertinent history. She had been suffering for the last four months from an intermittent, but very severe, drawing and burning pain on the volar aspect of the left hand extending into the thumb, index and the middle finger. The pain was worse at night, not aggravated by pronation or flexion of the arm, but relieved somewhat by hanging it down. There was no definite loss of strength of the grip of the hand. The patient spent sleepless nights.

Fig. 2. Lateral view. Spur in this view is unimpressive, but a slight concavity, smoothness and associated thinning of the cortex under the spur suggest pressure erosion.

Fig. 3. Oblique view (about 20 degrees of inward rotation). This view demonstrates the supracondyloid process to the full extent. A faintly outlined soft tissue shadow seems to fill the space between the supracondyloid process and the epicondyle (dotted line), is clearer on the original film.

Strain during recent moving and from holding a newborn baby, pressing its head against the left arm, were considered as possible contributing factors.

A bony prominence was not palpable, but pressure over the medial aspect of the left humerus above the elbow increased the pain for days.

The roentgenograms of the left lower humerus revealed the spur only partially in the lateral and slightly rotated anteroposterior view (Fig. 1 and 2). A view with inward rotation (about 20 degrees) showed the spur to its full extent

(Fig. 3). It was of triangular shape, measuring 13 mm. at the base, 10 mm. in length, and ending with a thin, short spur, the prolongation of which would have touched the tip of the medial epicondyle. The process resembled closely a short, curved beak. Underneath and distally from it, the cortex was over a zone of 2 cm. slightly smoother, thinner, and more concave, following which there was a small, sharp depression of the contour in an area of slight periosteal thickening above the medial epicondyle (Fig. 1, 2 and 3). A faintly outlined shadow appeared to fill this space. The comparative study of the other humerus failed to reveal a spur.

On the basis of these roentgen findings and symptoms of median nerve neuralgia, the patient was referred for removal of the supracondyloid process. At the operation (Dr. Frank P. Smith, Strong Memorial Hospital, Rochester, New York) the median nerve showed indentation from pressure against the inner side of the bony spur from which a ligamentous structure with fibers of the pronator teres muscle was extending toward the medial epicondyle.

In the first few days after removal of the spur there was marked regression of pain with slight paresthesia gradually disappearing. The patient has been now free of any symptoms for twenty-two months following the operation.

COMMENT

As a rule, only the bony part of the causative mechanism of the supracondyloid process appears in roentgenograms. In the lateral view, even in the most favorable profile, this small spur may be very unimpressive and hardly thought responsible for causing severe median nerve symptoms. Sometimes, as in the case cited above, the additional contour changes below the process make one suspicious that other causative factors are involved. In fact, in most of the few reported operative cases, (Mandruzzato,[5] Barnard and McCoy,[1] Solieri[10]) an abnormal ligament with fibers of pronator teres muscle was found spanning the gap between the process and the medial epicondyle and also pressing the nerve against the spur.

It is possible that the bony spur alone, without the attached fibrous band would be found in the majority of the asymptomatic cases. Nevertheless, with an incidence of supracondyloid process of 1 per cent among white persons, one would expect to find a higher rate of median nerve neuralgia than that which has been reported.

SUMMARY

A case of severe median nerve neuralgia due to the supracondyloid process, completely relieved by its removal, is presented. The causative mechanism is discussed.

95 Highland Avenue
Geneva, New York

The author wishes to express his gratitude to Frank P. Smith, M.D., Professor of Neurosurgery, University of Rochester, School of Medicine for the use of his operative report, and to Mr. William S. Cornwell for his technical assistance.

REFERENCES

1. BARNARD, L. B., and MCCOY, S. M. Supracondyloid process of humerus. *J. Bone & Joint Surg.*, 1946, *28*, 845–850.
2. CAFFEY, J. P. Pediatric X-Ray Diagnosis. Second edition. Year Book Publishers, Inc., 1950, p. 579.
3. CUNNINGHAM, D. J. Supracondyloid process in child. *J. Anat. & Physiol.*, 1899, *33*, 357–358.
4. GRUBER, W. L. Monographie des Canalis supracondyloideus humeri et femoris der Säugetiere und des Menschen. St. Petersburg, 1856.
5. MANDRUZZATO, F. Patologia e chirugia del processo supraepitrocleare dell' omero. *Chiz. d. ozg. di moviemento*, 1938, *24*, 123–132.
6. MORAIS, F. Sobre un caso de apofise supraepitrochl. con manisfetação clinica. *Imprensa Medica, Rio de Janeiro*, 1950, *26*, 438, 62–64.
7. MOREALI, G. Su quatro casi di proc. int. humeri. Modena, Casa Editrice Orlandi, 1923.
8. Morris' Human Anatomy. J. Parsons Schaeffer, Editor. Tenth edition. Blakiston Company, New York, 1942, p. 198.
9. PHALEN, G. S. Spontaneous compression of median nerve at wrist. *J.A.M.A.*, 1951, *145*, 1128–1133.
10. SOLIERI, S. Nevralgia del nervo mediano da processo sopraepitrocleare. *Chir. d. org. di movimento*, 1929, *14*, 171–180.
11. TERRY, R. J. Racial distribution of supracondyloid variation. *Am. J. Phys. Anthropol.*, 1930, *14*, 459–462.
12. TESTUT, L. L'apophyse susépitrochl. chez l'homme; vingt deux observ. *Internat. Monatsschr. f. Anat. & Physiol. Leipzig*, 1889, *6*, 391.

Vol. 76, No. 6

ASYMMETRY OF OSTEOPHYTOSIS IN THE THORACIC SPINE*

By GORDON J. CULVER, M.D., *and* HERBERT S. PIRSON, M.D.
BUFFALO, NEW YORK

OSTEOPHYTOSIS of the the spine is a condition in which there are osseous outgrowths at the margins of the vertebral bodies. This condition has frequently been called osteoarthritis of the spine. It is not a true arthritis, since the definition of arthritis is an inflammation of a true joint, and the union between the bodies of the vertebrae is not a true joint with an articular cavity and a secreting synovial membrane. Therefore, the term osteophytosis is preferable to describe bony overgrowth at the margins of the vertebral bodies, while the term osteoarthritis should be reserved for those cases in which there is involvement of the apophyseal joints by the same process that occurs in osteoarthritis of the extremities.

Osteophytes form at the vertebral margins secondary to disk degeneration. With disk degeneration there is loss of elasticity and thinning of the disk, so that the shock of minor trauma is no longer absorbed and there is damage to the cartilage plate and vertebral margin. This stimulates the vertebral body to produce new bone which takes the form of osteophytes.

Oppenheimer states that new bone is incapable of growing across normal connective tissue fibers.[8] Only in the annular area extending from the edge to the attachment of the longitudinal ligament is the vertebrae devoid of a ligamentous covering. Here the ligament is not adherent to the vertebrae and there is a potential empty triangular space between the vertical vertebral surface, the inner layer of the longitudinal ligament, and the fibers which connect the latter with the disk. An osteophyte can grow in this space until it meets the ligamentous fibers which bound it. If the degenerative disk becomes thinner the ligaments become looser and this triangular space becomes larger so that there is more room in which the osteophyte can grow.

Roentgenographically osteophytosis of the spine may resemble paraspinal ligament calcification. Several points may be used to differentiate the two conditions.

An osteophyte shows a variation in density. Cortex and cancellous bone may at times be as clearly differentiated as the body of the vertebrae itself. The osteophyte has a broader base and arises nearer the articular edge of the vertebral body. Osteophytes may, but rarely do, unite one vertebral body to the next.

A calcified paraspinal ligament is seen as a thickening of homogeneous density superimposed on the surface of the vertebrae and spanning the intervertebral space. Usually, both the calcified ligament and the vertebrae cast separate distinct shadows. Longstanding calcified paraspinal ligaments may ossify so that their texture resembles osteophytes. Also, frequently both paraspinal ligament calicfication and osteophyte formation may be present in the same spine.

It has been observed by the authors that osteophytosis in the thoracic spine is much greater on the right side than on the left side. Abrams[1] states that osteophytosis is more common on the right than on the left, but refers to no specific region in the spine and gives no explanation. Tobin and Stewart[15] have observed that osteophytes are predominantly unilateral. They believe that in right-handed persons they are usually mainly on the left side of the vertebral column and vice versa. The authors' observation of asymmetry has been limited to the thoracic spine, and the

* From the Department of Radiology of the University of Buffalo, and the Radiology Department of The Buffalo General Hospital, Buffalo, New York.

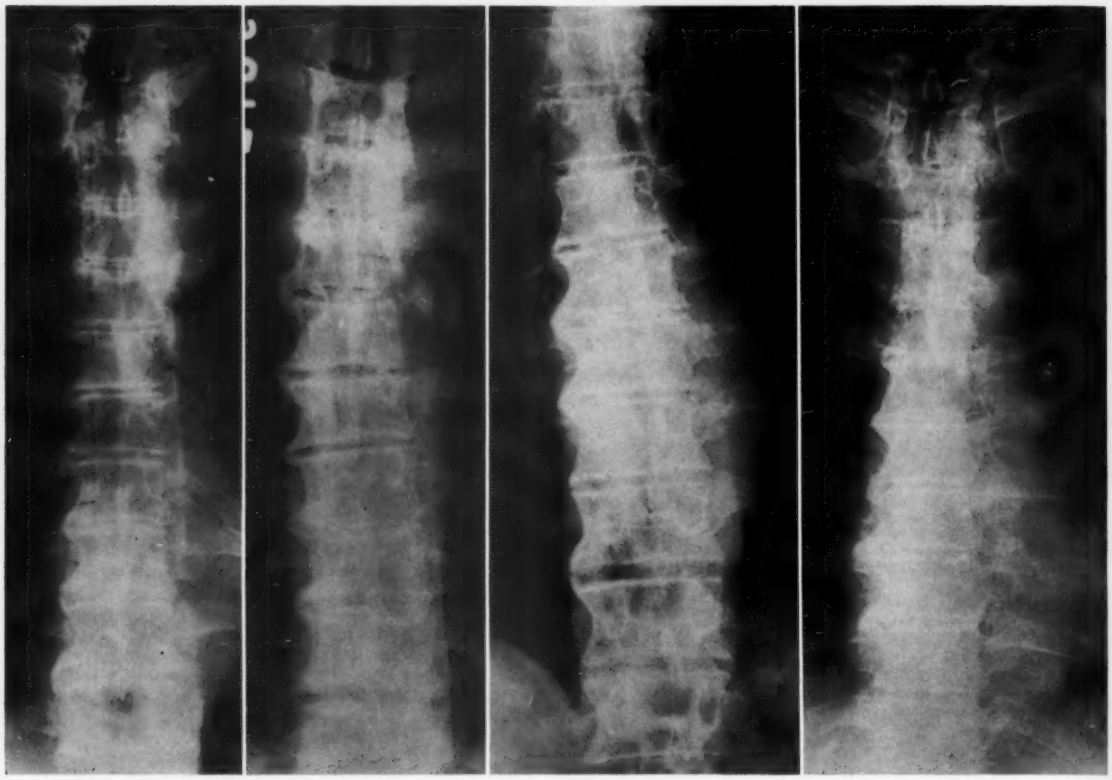


FIG. 1. Typical examples showing asymmetry of osteophytosis in the thoracic spine.

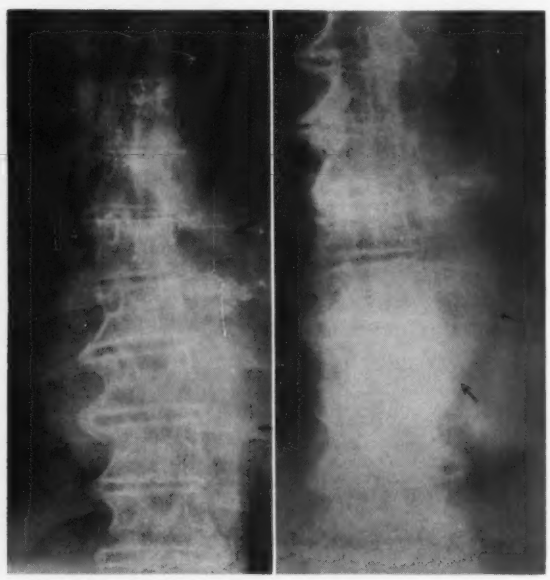


FIG. 2. Two examples showing how the osteophytes are bilateral inferior to where the aorta passes from a left lateral position to a more anterior position. The course of the aorta is outlined with arrows.

osteophytes have all been more extensive on the right side in both right and left handed persons.

Roentgenograms taken from typical cases to illustrate this fact are shown in Figure 1. There are frequently very extensive changes on the right side, with no evidence of changes on the left side. The entire thoracic spine does not show this difference, but only those vertebrae which are in apposition to the descending aorta. This is from about the fifth through the eleventh thoracic vertebrae. Below this level where the aorta is more anterior to the spine, the osteophytes are bilateral. Figure 2 illustrates this point well in 2 cases.

It would seem from this, that the presence of the pulsating aorta in apposition to the left lateral surface of the vertebral column is in some way responsible for this phenomenon. The relationship of the aorta to the thoracic spine may be seen in the

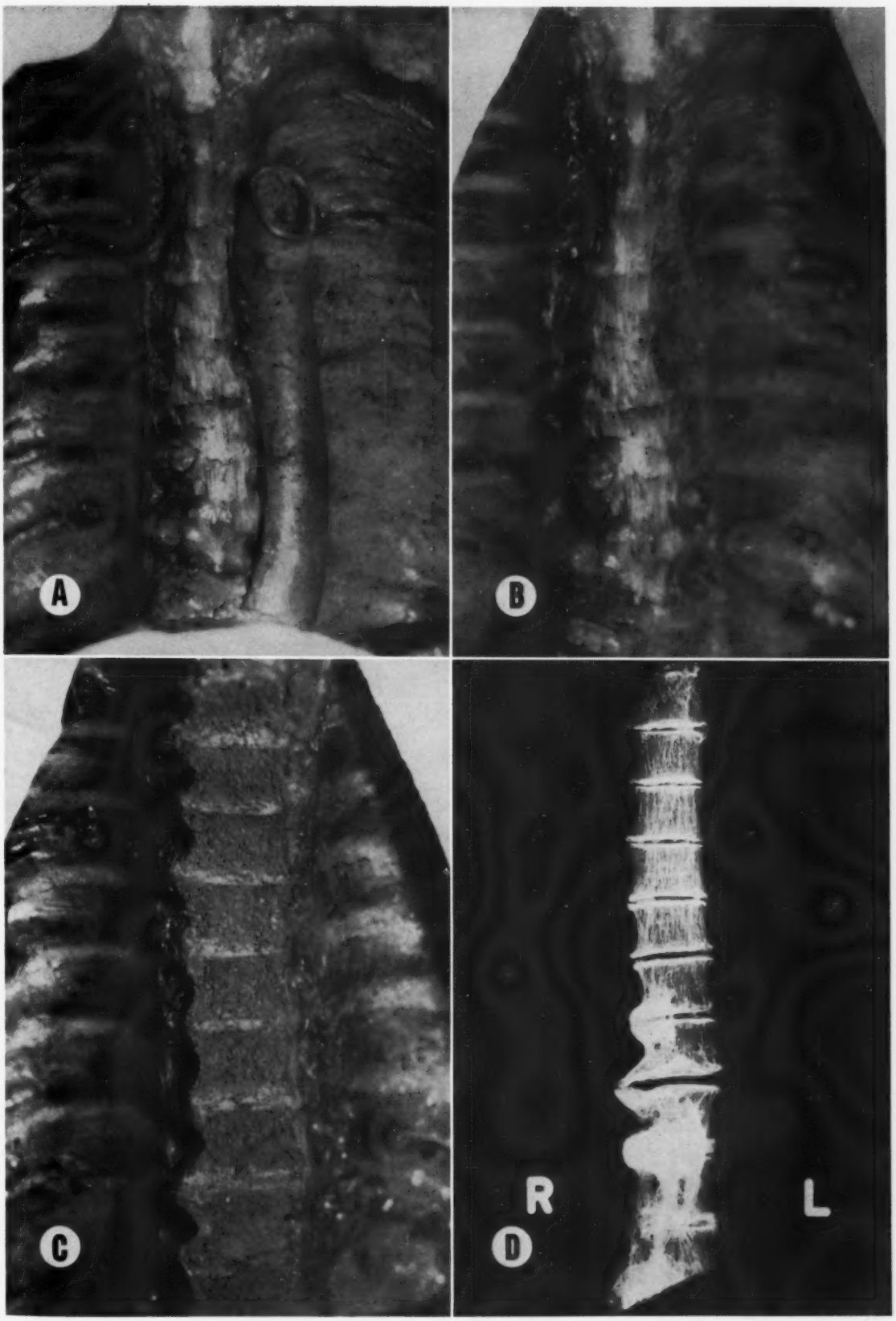


FIG. 3. (*A*) Dissection showing relationship of descending aorta to thoracic spine. (*B*) Same specimen with aorta removed. Note the asymmetry of osteophytosis. (*C*) Same specimen cut in coronal section. (*D*) Roentgenogram of the specimen.

dissection illustrated in Figure 3. This dissection also demonstrates the asymmetry of osteophytosis. It should be emphasized that this asymmetry is not a rare finding, but was found in all cases we have examined both roentgenographically and by dissection in which there has been osteophyte formation.

Just how the aorta may be related to this asymmetry of osteophytosis may be speculated upon. It is well known that in the presence of an aneurysm of the aorta, there is pressure erosion of adjacent vertebral bodies. Scalloping of the surface of the vertebral bodies is the first indication of pressure absorption. As the process continues, the erosion becomes deeper. The intervertebral disks can resist the erosion of the aneurysm, and the bone in close relation to the disks is protected by them. Therefore, the intervertebral disks and bone adjacent to the disks are not involved until there is considerable erosion of the vertebral bodies. It may be that there is a similar explanation in the case of the normal pulsating aorta pressing on the vertebral bodies and preventing new bone formation, to that of an aneurysm of the aorta causing bone absorption.

Another factor which may enter into the cause of the lack of osteophyte formation adjacent to the aorta is the possible obliteration of the annular area of which Oppenheimer speaks by the pressure of the aorta, so that there is no room for the osteophyte to be able to grow.

We would feel that, whatever the exact cause of this asymmetry may be, it is important for anyone examining roentgenograms of the thoracic spine to be aware of it.

SUMMARY

The authors wish to point out the asymmetry of osteophytosis in the thoracic spine. Osteophytes are found on the right side, but not on the left side, on those vertebrae along which the descending aorta is in apposition laterally on the left. This is not a rare finding, being present in all cases which show osteophytosis of the thoracic spine. It appears that aortic pulsations have a definite preventive effect on osteophyte formation.

Gordon J. Culver, M.D.
The Buffalo General Hospital
100 High Street
Buffalo, New York

REFERENCES

1. ABRAMS, N. R. In: Hollander, J. L., Comroe's Arthritis and Allied Conditions. Fifth edition. Lea and Febiger, Philadelphia, 1953.
2. BOLAND, E. W., and SHEBESTA, E. M. Rheumatoid spondylitis; correlation of clinical and roentgenographic features. *Radiology*, 1946, *47*, 551–556.
3. BORAK, J. Spondylosis and spondylarthritis. *Ann. Int. Med.*, 1947, *26*, 427–432.
4. BRAILSFORD, J. F. Aneurysm of abdominal aorta; diagnosis by lateral radiograph of the spine. *Brit. J. Surg.*, 1926, *14*, 369–371.
5. BRAILSFORD, J. F. Roentgenography of spine. AM. J. ROENTGENOL. & RAD. THERAPY, 1927, *18*, 123–129.
6. BRAILSFORD, J. F. The Radiology of Bones and Joints. Fifth edition. Williams & Wilkins Company, Baltimore, 1953.
7. GEORGE, A. W. Use and abuse of the term hypertrophic arthritis relative to marginal changes in vertebrae. *Radiology*, 1941, *36*, 745–647.
8. OPPENHEIMER, A. Calcification and ossification of vertebral ligaments (spondylitis ossificans ligamentosa); roentgen study of pathogenesis and clinical significance. *Radiology*, 1942, *38*, 160–173.
9. OPPENHEIMER, A. Diseases of vertebral column; roentgenologic analysis. AM. J. ROENTGENOL. & RAD. THERAPY, 1945, *53*, 348–369.
10. POLLEY, H. F., and SLOCUMB, C. H. Rheumatoid spondylitis. *Ann. Int. Med.*, 1947, *26*, 240–249.
11. PUGH, D. G. In: Golden, R., Diagnostic Roentgenology. Thos. Nelson & Sons, New York, 1950.
12. SCHAEFFER, J. P. Morris' Human Anatomy. The Blakiston Company, Philadelphia, 1942.
13. SHORE, L. R. On osteo-arthritis in dorsal intervertebral joints; study in morbid anatomy. *Brit. J. Surg.*, 1935, *22*, 833–849.
14. SHORE, L. R. Polyspondylitis marginalis osteophytica. *Brit. J. Surg.*, 1935, *22*, 850–863.
15. TOBIN, W. J., and STEWART, T. D. In: De Palma, A. F., Clinical Orthopedics No. 2. J. B. Lippincott Company, Philadelphia, 1953.
16. WILLIAMS, E. R. In: Shanks, S. C., and Kerley, P. A., Textbook of X-ray Diagnosis, W. B. Saunders, London 1950.

Vol. 76, No. 6

ISCHIAL EPIPHYSIOLYSIS

By CHESTER A. STAYTON, Jr., M.D.
INDIANAPOLIS, INDIANA

IN 1953, an unfamiliar abnormality of the bony pelvis was discovered accidentally by the writer while performing an examination of the colon on a patient who had no symptoms referable to the skeleton. Examination of the American radiologic literature failed to disclose a report of a similar case, though several cases, obviously similar, were found to be reported in *The Journal of Bone & Joint Surgery* and other orthopedic journals. The recent opportunity to examine a second case of avulsion of the ischial tuberosity has prompted this report of an unusual and possibly unsuspected syndrome which may be encountered by the roentgenologist.

Ischial epiphysiolysis, or hamstring avulsion of the secondary ossification center or "epiphysis" of the ischial tuberosity, has also been named ununited epiphysis,[9] avulsion fracture,[13] epiphysitis,[5] nonunion,[7] and apophysiolysis[6] of the tuberosity. The first case reported by an American was by Berry in 1912,[2] and the subject has been well summarized recently by Milch.[6]

The ossification center under discussion becomes evident at puberty and unites with the body of the ischium at about the age of twenty-five. Strictly speaking, it is not an epiphysis, since it is not part of a long bone, but common usage makes that term acceptable. It is generally agreed that trauma is the only causative agent involved, particularly trauma associated with the strenuous activities of males in the twelve to twenty-five year age group. Most of the reported patients have been athletes and most were injured while running or jumping. Football and track are the sports often implicated. Cohen[3] writes that the injury may occur when there is a "sudden forceful pull on the ischial tuberosity while the pelvis is fixed in flexion, or a sudden flexion of the pelvis with the lower extremity fixed and the knee in extension, or a combination of both."

All reported cases have been injured in the aforementioned age range when the epiphysis develops and unites. Milch[6] states that there have been two case reports involving girls and that the injury may be bilateral. Peculiarly enough, in most cases the left side is affected, as was true of the two cases reported here.

Absence of related symptoms is common in those patients whose ischial avulsions occurred several years prior to detection. Occasionally, the complaint of gluteal pain with prolonged sitting is voiced. Severe pain and tenderness in the gluteal region of the involved side have been the most consistent complaints in patients examined shortly after injury. The pain is invariably worsened by stretching of the hamstring muscles; hence, limping is to be expected.

Roentgenographic changes are minimal in the acute cases, consisting of separation of the ossification center, possibly with some displacement. In the late cases, however, the findings are striking and characteristic. A crescentic mass of bone, often partially fragmented, is seen in the soft tissue adjacent to the tuberosity of the ischium. This mass is as large or larger than the normal tuberosity and suggests, in appearance, a duplication of that structure. It may appear to be partially united with the body of the ischium and the line of separation between the two is irregular. Cohen[3] states that the only entity to be differentiated is ossifying hematoma.

Conservative treatment of bed rest with the knee flexed, heat, and possibly injection of procaine into the site of injury is the recommended management for ischial epiphysiolysis. Attempts at reattachment of the avulsed epiphysis by surgical means have not been very satisfactory, though relief of late symptoms has been accomplished by excision of the mass. Several weeks of rest may be required for relief of the pain, which may recur with a resump-

Fig. 1. Case 1. Ancient epiphysiolysis of left ischial tuberosity.

tion of athletics. No treatment is advised for the patients with ancient asymptomatic avulsions. The end result is usually satisfactory with conservative treatment.

REPORT OF CASES

Case 1 (Fig. 1). White male, aged thirty-seven, had no symptoms referable to the pelvis or lower extremities. Old epiphysiolysis of the left ischial tuberosity was noted on roentgenograms made in the course of performing a barium enema to determine a possible cause of anemia. He had broad-jumped and played football and baseball in high school, and had played amateur baseball after graduation. He could recall no specific incidents of injury, however. The mass in the left gluteus was palpable but not tender. No treatment was advised.

Fig. 2. Case II. Fragmentation of old separated ischial "epiphysis" on left.

Case II (Fig. 2). White male, aged forty-seven, had pain in the low back, radiating to the right lower extremity. The symptoms and signs were characteristic of herniated disk at the lumbosacral interspace on the right. Roentgenograms of the lower spine and pelvis revealed old epiphysiolysis of the left ischial tuberosity. The mass was palpable and nontender. It was felt that the clinical symptoms were in no way related to the injury. The patient had been a "broncho-buster" in his youth and recalled an injury incurred when he was seventeen years of age, during the act of breaking a horse, while he sat very hard on the saddle with his left gluteal region. He was at that time unable to walk for a week because of severe pain in the left buttock, and had pain intermittently in that region for twenty years. Treatment for the epiphysiolysis was not advised.

SUMMARY

Two patients with ischial epiphysiolysis are reported. They are classed in the late, asymptomatic group, since both sustained their injuries some years before diagnosis.

313 Hume Mansur Building
Indianapolis, Indiana

REFERENCES

1. Abbate, C. C. Avulsion fracture of ischial tuberosity; case report. *J. Bone & Joint Surg.*, 1945, *27*, 716–717.
2. Berry, J. M. Fracture of tuberosity of ischium due to muscular action. *J.A.M.A.*, 1912, *59*, 1450.
3. Cohen, H. H. Avulsion fracture of ischial tuberosity. *J. Bone & Joint Surg.*, 1937, *19*, 1138–1140.
4. Labuz, E. F. Avulsion of ischial tuberosity; report of case. *J. Bone & Joint Surg.*, 1946, *28*, 388–389.
5. McMaster, P. E. Epiphysitis of ischial tuberosity; case report. *J. Bone & Joint Surg.*, 1945, *27*, 493–495.
6. Milch, H. Ischial apophysiolysis; a new syndrome. *Bull. Hosp. Joint Dis.*, 1953, *14*, 188–193.
7. Scott, W. Non-union of ischial tuberosity associated with epiphysitis vertebrae; report of case. *J. Bone & Joint Surg.*, 1946, *28*, 862–864.
8. Watson-Jones, R. Fractures and Joint Injuries. Vol. I. Williams & Wilkins Company, Baltimore, 1943.
9. Winkler, H., and Rapp, I. H. Ununited epiphysis of the ischium; report of case. *J. Bone & Joint Surg.*, 1947, *29*, 234–236.

VOL. 76, NO. 6

A METHOD OF MEASURING THE FEMORAL NECK IN SURGICAL TREATMENT OF FRACTURES OF THE HIP*

By EDMUND VAN BRUNT, B.A.
OAKLAND, CALIFORNIA

ONE of the problems confronting the orthopedist during surgical fixation of fractures of the subcapital, neck, and intertrochanteric regions of the femur is the accurate determination of the length of the Smith-Petersen, Neufeld, or other type of nail to be used. Failure to ascertain the correct length frequently results in loss of time and undesirable osseous trauma due to the necessary withdrawal of the nail and re-insertion of one of appropriate size.

The purpose of this paper is to present a rapid method of measuring in the operating room the length of the path which the nail is to follow, so that the surgeon may know the length desired after he has both manipulated and immobilized the femur and is ready to insert his nail of choice. The measurement, taking but a few moments, may be effected by the surgeon, one of his assistants, or the radiologic technician.

After manipulation and immobilization of the affected leg roentgenograms in the usual anteroposterior and lateral projections are made with the following factors observed: the central ray is directed so that it closely approximates the perpendicular bisector of the femoral neck in the horizontal plane (Segment *TO*, Fig. 3). Anteroposterior projection: target-film distance = 25 inches.[1] Lateral projection: usual procedure; distance immaterial. The greater trochanter-film distance is noted.

An ordinary ruler, calibrated in inches and subdivided at least to quarter-inches, is then used for measuring directly on the wet roentgenogram that part in which the surgeon is interested, for example, segment *AB*, in Figure 1. The true length of the part measured is then read directly from a graph constructed to correct for the magnification present (Fig. 2). On the ordinate the length measured on the wet film is observed. The true length is then read on the abscissa below the point of intersection of the horizontal line representing the measured value and the diagonal line representing the film-greater trochanter distance, noted above.

The graph is constructed by using the simple geometric relationship shown in

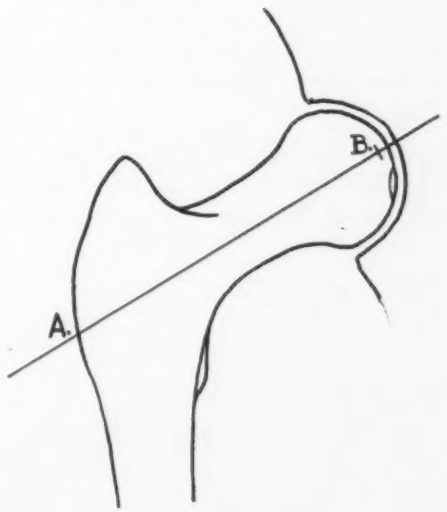


FIG. 1

Figure 3. By substituting variable nail lengths *AB* into the relation shown, a series of "magnified" lengths may be found for given target-film and greater trochanter-film values.

At first glance it would seem that there is one immediate source of error, namely that incurred by rotation of the leg causing an increase or decrease of the angle formed

[1] It is upon this distance that the construction of the graph (Fig. 2) is based. Thus, once a graph has been constructed, the corresponding target-film distance must remain constant.

* From the Department of Radiology, Samuel Merritt Hospital, Oakland, California.

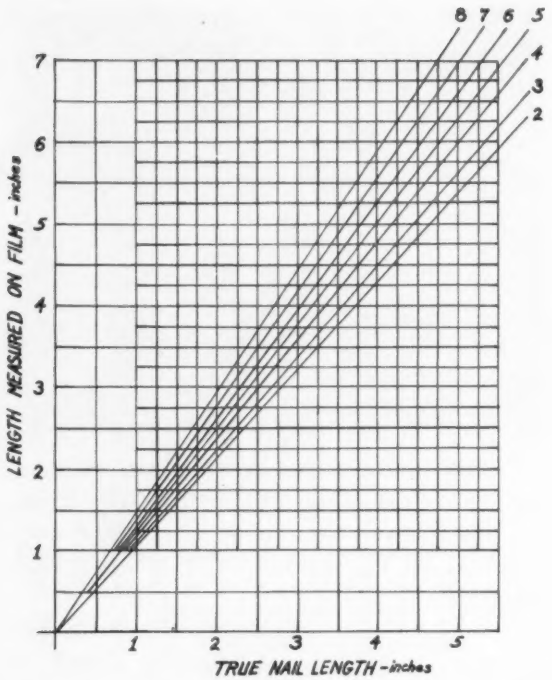


Fig. 2. The numbers from 2 to 8 heading the diagonal lines represent the greater trochanter-film distance in inches. The above graph is based on a target-film distance of 25 inches.

by the intersection of line AB (the axis of the femoral neck) with the horizontal plane (Fig. 4). This results in a foreshortening of the image on the roentgenogram which is also distorted by the primary beam.

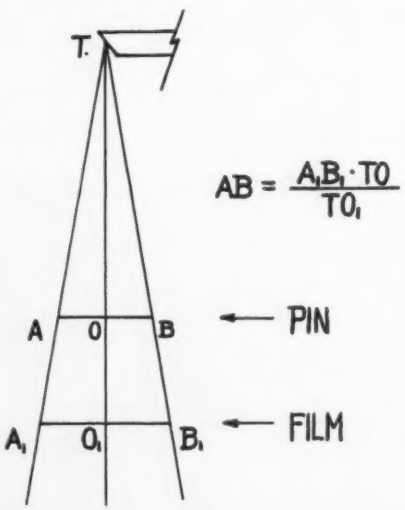


Fig. 3. T represents the target, AB the level of the pin, A_1B_1 the level of the film, TO_1 the central ray of the primary beam. By holding the ratio A_1B_1/TO_1 constant the ratio AB/TO may be determined for any given length AB.

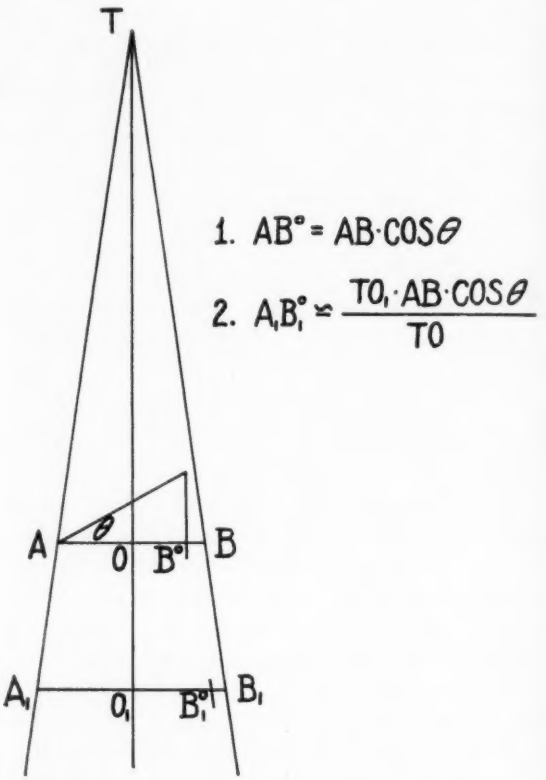


Fig. 4. This relation demonstrates the true nail length, in the ideal case, as a function of the angle produced (by rotation of the femur) between the axis of the femoral neck and the horizontal plane. The approximation obtains as a result of the cosine function being non-linear. As theta becomes smaller the expression approaches equality.

From Figure 4 it is clear, in the ideal case, that by using the true length as a function of the angle theta a correction factor may be found for any given value of theta.

When taking into consideration the relatively small angle produced by rotation of the leg through comparatively large arcs, the partially compensated foreshortening becomes negligible for inclinations up to approximately fifteen degrees.[2] The correction factors for larger angles have not been included, since in the experience of

[2] At 15°, assuming a 4 inch femoral neck, and a greater trochanter-film distance of 5 inches, the error is approximately ¼ inch.

orthopedists with whom the writer is acquainted this angle has rarely been exceeded. In that the desired accuracy is limited to one-quarter inch by the fact that the fixation devices are so graded, a determination of correction factors for intervals of less than fifteen degrees is unnecessary. Thus, the margin of greatest error is that resulting from the gradations of nails currently in use.

In conclusion it may be stated that this method has been used at the Samuel Merritt Hospital on a representative number of cases, under the surveillance of eight qualified orthopedic surgeons. In all cases the results were deemed satisfactory.

SUMMARY

A method has been presented by which the length of the femoral neck may be determined in order that the orthopedic surgeon may select a nail of appropriate length in surgical treatment of fractures of the subcapital, neck, and intertrochanteric regions of the femur.

Department of Radiology
Samuel Merritt Hospital
Oakland, California

THE AMERICAN JOURNAL OF ROENTGENOLOGY, RADIUM THERAPY AND NUCLEAR MEDICINE

Editor: LAWRENCE REYNOLDS, M.D.

Associate Editors: HARRY HAUSER, M.D., TRAIAN LEUCUTIA, M.D., RUSSELL H. MORGAN, M.D., EDWARD B. D. NEUHAUSER, M.D., WENDELL G. SCOTT, M.D.

Consulting Editorial Board: See front cover.

Published by: CHARLES C THOMAS, PUBLISHER, 301–327 East Lawrence Avenue, Springfield, Illinois.

Issued monthly. Annual subscription: United States, Mexico, Cuba, Central and South America, $15.00; Canada, $16.00; other countries, $17.00. Current single numbers, $1.50. Advertising rates submitted on application. Editorial office, 110 Professional Building, Detroit 1, Michigan. Office of publication, 301–327 East Lawrence Avenue, Springfield, Illinois. Information of interest to authors and readers will be found on page vi.

Officers and Standing Committees

AMERICAN ROENTGEN RAY SOCIETY

President: W. Edward Chamberlain, Philadelphia Pa.; *President-Elect:* Wendell G. Scott, Clayton, Mo.; *1st Vice-President:* Vincent W. Archer, Charlottesville, Va.; *2nd Vice-President:* Philip J. Hodes, Philadelphia, Pa.; *Secretary:* Barton R. Young, Germantown Hospital, Philadelphia 44, Pa.; *Treasurer:* Robert K. Arbuckle, Samuel Merritt Hospital, Hawthorne and Webster Sts., Oakland 9, Calif.

Executive Council: W. E. Chamberlain, W. G. Scott, V. W. Archer, B. R. Young, R. K. Arbuckle, Lawrence Reynolds, E. L. Jenkinson, H. B. Elkins, J. F. Holt, P. C. Hodges, J. C. Dickinson, J. C. Cook, R. M. Caulk, C. A. Good, A. E. Childe, Wilbur Bailey, E. B. D. Neuhauser, Chairman, 300 Longwood Ave., Boston, Mass.

Program Committee: B. R. Young, Philadelphia, Pa., H. B. Elkins, Iowa City, Iowa, Lawrence Reynolds, Detroit, Mich., J. F. Holt, Ann Arbor, Mich., E. B. D. Neuhauser, Boston, Mass., H. O. Peterson, St. Paul, Minn., Wendell G. Scott, Chairman, Clayton, Mo.

Publication Committee: H. G. Reineke, Cincinnati, Ohio, V. P. Collins, Houston, Texas, J. F. Roach, Albany, N. Y., H. M. Stauffer, Philadelphia, Pa., Higdon B. Elkins, Chairman, Iowa City, Iowa.

Finance and Budget Committee: Wilbur Bailey, Los Angeles, Calif., A. E. Childe, Winnipeg, Manitoba, L. W. Paul, Madison, Wis., J. E. Miller, Dallas, Texas, Edward L. Jenkinson, Chairman, Chicago, Ill.

Committee on Scientific Exhibits: R. H. Marshak, New York, N. Y., Cesare Gianturco, Urbana, Ill., John F. Holt, Chairman, Ann Arbor, Mich.

Representative on American Board of Radiology: H. D. Kerr, St. Michaels, Md., T. Leucutia, Detroit, Mich., B. R. Kirklin, Rochester, Minn.

Director of Instructional Courses: H. O. Peterson, St. Paul, Minn., *Manager of Annual Meeting:* James C. Cook, 110 Professional Building, Detroit 1, Mich.

Editor: Lawrence Reynolds, 110 Professional Building, Detroit 1, Mich.

Fifty-eighth Annual Meeting: Shoreham Hotel, Washington, D. C., October 1–4, 1957.

AMERICAN RADIUM SOCIETY

President: Norman McCormick, Windsor, Ontario, Canada; *President-Elect:* Douglas J. Roberts, Hartford, Conn.; *1st Vice-President:* Franklin L. Payne, Philadelphia, Pa.; *2nd Vice-President:* George W. Waterman, Providence, R. I.; *Secretary:* Theodore R. Miller, New York, N. Y.; *Treasurer:* Jesshill Love, St. Joseph Infirmary, Louisville, Ky.

Executive Committee: Edith H. Quimby, Chairman, New York, N. Y.; John E. Wirth, Pasadena, Calif.; Grant H. Beckstrand, Long Beach, Calif.

Program Committee: Norman McCormick, Chairman, Windsor, Ontario, Canada; Edith H. Quimby, New York, N. Y.; Clifford Ash, Toronto, Ontario, Canada; A. N. Arneson, St. Louis, Mo.; Ex officio, Douglas J. Roberts, Hartford, Conn.

Publication Committee: Harry Hauser, Chairman, Cleveland, Ohio; Martin Van Herik, Rochester, Minn.; R. C. Hildreth, Kalamazoo, Mich.

Public Relations Committee: Ethlyn Trapp, Chairman, Vancouver, B. C., Canada; J. E. Stapleton, Halifax, Nova Scotia, Canada; Edward J. Tabah, Montreal, Canada.

Janeway Lecture Committee: Douglas Quick, Chairman, New York, N. Y.; Gioacchino Failla, New York, N. Y.; H. Dabney Kerr, St. Michaels, Md.

Representatives on the American Board of Radiology: Douglas Quick, New York, N. Y.; B. P. Widmann, Philadelphia, Pa.; Frederick W. O'Brien, Boston, Mass.

Representatives on National Committee on Radiation Protection: Edith H. Quimby, New York, N. Y.; Theodore P. Eberhard, Ann Arbor, Mich.

Committee on Arrangements: Carleton B. Peirce, Chairman, Montreal, Quebec, Canada; Ethlyn Trapp, Vancouver, B. C., Canada; Origene Dufresne, Montreal, Quebec, Canada; Thomas Glen Stoddart, Ottawa, Ontario, Canada; T. A. Watson, Saskatoon, Saskatchewan, Canada; M. Vera Peters, Toronto, Ontario, Canada; Norman McCormick, Windsor, Ontario, Canada.

Representative on the Board of Chancellors of the American College of Radiology: Charles L. Martin, Dallas, Texas.

Thirty-ninth Annual Meeting: Chateau Frontenac, Quebec, Canada, May 30–June 1, 1957.

EDITORIAL

FIFTY-SEVENTH ANNUAL MEETING OF THE AMERICAN ROENTGEN RAY SOCIETY

AFTER an interval of thirty-four years, the American Roentgen Ray Society returned to Los Angeles, California, for its Annual Meeting, and in reading the Program of that year's meeting (1922) under the Presidency of Dr. William H. Stewart* of New York City, one may be impressed by the tremendous advances in all phases of radiology made since that time.

The whole field of opacification with newer types of media has not only been introduced in the interval, but its use has progressed to the point where it constitutes a routine procedure in departments throughout the world in examinations of the cardiovascular system, urinary tract, lungs, brain, and spinal cord. No longer are the radiologist, the internist and the surgeon relying on indirect signs in the radiologic examination of the gallbladder, such as was in vogue at the time of the meeting in 1922. Thanks to the epoch-making work of Drs. Graham, Cole, and Moore, we are now able to visualize with unbelievable accuracy the normal as well as the abnormal functioning of the gallbladder, and are able to demonstrate the presence or absence of gallstones.

In the realm of radiotherapy, the megavoltage apparatus and radioactive isotopes were then unknown.

This year's Annual Meeting was held at the Statler Hotel, September 25 to 28, under the presidency of Dr. W. Edward Chamberlain. Although it has passed into history, it will be long remembered for the high caliber of the scientific papers, the superb display of scientific exhibits, and the pleasant social events, as well as the unusual and comprehensive technical exhibits.

* Deceased.

The program, which had been arranged by President-Elect W. Edward Chamberlain and his Committee, was an excellent one in all respects.

The Scientific Session was opened on Tuesday morning with a call to order by President Paul C. Hodges, and the Address of Welcome was given by Dr. Robert Gordon Sproul, President of The University of California. Dr. Sproul's address was a prologue to the Scientific Program which followed immediately upon the installation of President-Elect W. Edward Chamberlain as President.

Dr. Chamberlain was inducted into office by President Paul C. Hodges and the Chairman of the Executive Council, Harold O. Peterson.

Immediately following his installation, Dr. Chamberlain in his Inaugural Address gave an interesting discussion on the *Benefits to Mankind through Integration of Physiology and Radiology*. The address of Dr. Chamberlain was followed by a group of interesting papers dealing with such important topics as *Physiology Revealed by the Roentgen Ray* by Dr. Herbert M. Stauffer of Philadelphia, Pennsylvania, and his associates; *Cardiac Ventriculography—Direct Transthoracic Needle Puncture Opacification of the Left (or Right) Ventricle* by Dr. J. Stauffer Lehman, Philadelphia, Pennsylvania, and associates; *Dissecting Aneurysm of the Thoracic Aorta—Its Roentgen Recognition* by Dr. Stanley M. Wyman, Boston, Massachusetts; *Arteriographic Manifestations of Occlusive Vascular Disease* by Dr. Alexander R. Margulis and his co-workers, Minneapolis, Minnesota; *Aids in the Diagnosis of of Mediastinal Tumors* by Dr. W. Emory

Burnett and his co-workers, Philadelphia, Pennsylvania; *Pulmonary Alveolar Lithiasis—Preliminary Report* by Dr. Allan B. Skorneck and Dr. Raymond Yesner of West Haven, Conneticut; *The Familial Occurrence of Pulmonary Alveolar Microlithiasis* by Dr. Merrill C. Sosman and his colleagues, Boston, Massachusetts; and *The Significance of the Luminance Gradient in Diagnostic Chest Roentgenography* by Dr. William J. Tuddenham of Philadelphia, Pennsylvania.

As customary, the afternoon periods were reserved for the Instructional Courses, with time also allotted for viewing of the Scientific and Technical Exhibits.

Tuesday evening, the Annual Caldwell Lecture was given by Dr. Oscar V. Batson, Professor of Anatomy and Chairman of the Department of Anatomy of the Graduate School of Medicine, The University of Pennsylvania, Philadelphia, Pennsylvania. Dr. Batson was introduced by his fellow townsman, Dr. Bernard Pierre Widmann. The topic of Dr. Batson's discussion was *The Vertebral Vein System.* It was a splendid lecture on a most interesting subject. Being an authority of the first rank on the vertebral vein system, Dr. Batson emphasized the importance of this system of veins and the part they play in the dissemination of both infectious and metastatic processes from the pelvic regions. Following Dr. Batson's address, President Chamberlain presented him with the Caldwell Medal.

On Wednesday the Scientific Program was continued with a presentation of a group of papers on diversified subjects beginning with the *Program and Activities of the American College of Radiology in the Field of Public Relations* by Dr. Wendell G. Scott of St. Louis, Missouri, who has played an important part in the Public Relations Commission of the American College of Radiology of which he is Chairman. Then followed a discussion on *Diffuse Calcification of the Pancreas* by Dr. Chauncey K. McGeorge of Philadelphia, Pennsylvania, and *A Roentgen and Esophagoscopic Study of Esophagitis* by Dr. Richard H. Marshak of New York, in association with Dr. Bernard S. Wolf and Dr. Max Som. The next paper was one dealing with *Studies of Esophageal Varices before and after Porta-caval Shunts* by Dr. John A. Evans and Dr. Mary Ann Payne of New York City. Other papers of interest and the authors who presented them were as follows: *The Association of Volvulus of the Cecum and Ascending Colon with Other Obstructive Colonic Lesions* by Dr. Max Ritvo and his associates of Boston, Massachusetts; *Significance of Regional or Reflex Ileus in the Roentgen Diagnosis of Cholecystitis, Perforated Ulcer, Pancreatitis and Appendiceal Abscess, As Determined by Survey Examination of the Acute Abdomen* by Barton R. Young of Philadelphia, Pennsylvania. In his discussion Dr. Young demonstrated the great value of survey film examination in cases exhibiting acute abdominal conditions. The presentation was an excellent one on a topic of timely importance to all radiologists, as well as physicians and surgeons. Dr. William A. Evans and Dr. Robert L. Willis, Detroit, Michigan, presented a paper on *Further Observations on the Diagnosis of Hirschsprung's Disease in Infants.* Their study concerned itself with observations made in 20 cases since 1953. From an analysis of these cases, their observations led them to believe that the diagnosis is more appropriately one of pathologic physiology than of pathologic anatomy. Attention was called to the most reliable early diagnostic signs in the recognition of stasis in the colon following barium enema studies, and also to other features dealing with Hirschsprung's disease.

Dr. Harold Fulton gave a paper on *Delayed Cystography in Children,* a too neglected method of examination in upper urinary tract infection of children. Dr. Fulton was fortunate in having as one of his discussants Dr. Charles Montgomery Stewart, who was the first to make the observation of the importance of delayed cystography in the diagnosis of urinary tract diseases in children. The following

paper, *Roentgen Findings in Ureteral Colic* by Dr. Harold O. Peterson and Dr. George B. Ellenz, both of St. Paul, Minnesota, stressed the fact that "96–98 per cent of all ureteral calculi should be visible on plain films of the urinary tract."

The Thursday morning Scientific Session was devoted to problems dealing with radiation therapy of various types. The first paper was that of Dr. Bernard Roswit and his associates of New York City, entitled *The Art of Mold Technology in Radiation Treatment of Cancer.* Other papers concerning problems of radiation therapy were: *Effects of Radiation Quality, Target Axis Distance, and Field Size on Dose Distribution in Rotation Therapy* by Edith H. Quimby, Sc.D. and Beverly S. Cohen, B.A., of New York City, which dealt with the relation between maximum skin dose and axis dose in rotation therapy; a topic of prime importance. *Radiation Characteristics of a Kilocurie Revolving Cobalt-60 Therapy Unit* by Drs. Lawrence H. Lanzl, and Lester S. Skaggs, Chicago, Illinois. Based on their studies using this type of therapy unit, they emphasized the desirability of making the physical size of the source as small as possible. *Production and Properties of High Energy Electrons for Therapy* was given by J. W. Beattie, M.S., and his group at the Memorial Center, New York City, in which they stated that the Memorial Center betatron has been developed to provide an external electron beam with energy adjustable from 5 mev. to 24 mev. and with field sizes ranging in area from 2 cm.^{2} to 225 cm.^{2}. The effect of various combinations and weightings of fields and energies have been calculated during their studies. Another presentation, *Treatment Planning in Therapeutic Application of High Energy Electrons to Head and Neck Cases,* was given by K.C. Tsien and his associates of the Memorial Center, New York City. These authors discussed techniques in the use of the betatron as applied in the treatment planning in multiple fields in lesions of the head and neck. Comparison was made with the dose distributions produced by 250 kv. peak roentgen rays in alike cases. Dr. Douglas Quick and Jeanne Delano Richmond, A.B., New York City, gave a most interesting and stimulating discussion on *Is Radium Still Necessary?* In their splendid contribution they called attention to the fact that many teaching programs are seriously in need of re-orientation in order to give proper import to training in the use of radium. *Radiotherapy of Carcinoma of the Accessory Nasal Sinuses with Consideration of an Intracavitary Multiple Source Treatment Procedure* was the title of the subject by Dr. Paul M. St. Aubin and his associates of Boston. This was a worthy paper based on the cases seen at the Massachusetts General Hospital and the Massachusetts Eye and Ear Infirmary during the period 1930 to 1950. *Epidermoid Carcinoma of the Lower Lip: Results of Radiation Therapy of the Local Lesion* was an important discussion given by Dr. William S. Gladstone and Dr. H. Dabney Kerr. Their major interest was the study of the end results in the treatment of the local lesions. They stated their present concept of therapy techniques in cases of this type.

The Friday morning Scientific Session consisted of a group of papers dealing with a variety of subjects. Among these was *Acquired Resistance to Roentgen Irradiation in Experimental Lymphoma* by Dr. Charles M. Nice, Jr. Another had as its subject *Evaluation of Indications for Radioactive Iodine Therapy of Thyroid Cancer* by Dr. Robert Robbins and Jean Meszaros Benninghoff, M.S. In their discussion these authors stressed the importance of "an attempt to examine the basis for such radiotherapy, including an examination of the dosimetry of both the tumor and the body as a whole, using metabolic analysis and to employ such dosage concepts as are current in x-ray and radium therapy—balancing the achievable 'tumor dose' and homogeneity against the 'blood dose,' and the hazards implied by the latter." The analysis of their cases suggested

several lines of modification of therapy. An interesting paper was *A Method for Visualization of the Configuration and Structure of the Liver* by Drs. Hymer L. Friedell, William J. MacIntyre, and Abbas Rejali, who stated that "when compounds which are metabolized by the liver are tagged with a suitable radioelement, it is possible by special scanning techniques to make certain records and observations. The general conformation of the liver may be readily detected on special scanograms and alterations from the normal may be observed." They discussed not only the advantages of the method but also its limitations. Another paper dealing with the useful procedure for localizing spinal block lesions, namely, *Myelo-Scintography*, was given by Drs. Charles R. Perryman, Paul R. Nobel and Floyd H. Bragdon, of Pittsburgh, Pennsylvania. According to these authors, "myelo-scintography is a relatively new diagnostic procedure which has been added to the armamentarium of Radiologist and Neurosurgeon. The procedure is a relatively simple one utilizing hemin serum albumin packed with radioactive Iodine I^{131} (RISA) for the study of the gross anatomy of the subarachnoid space of the spinal cord. The patient's thyroid is protected by the administration of Lugol's solution usually 24 to 48 hours prior to the examination unless the patient's condition dictates immediate surgery." From their observations Dr. Perryman and his co-workers have come to believe that this technique is of particular value in patients having clinical evidence of partial or complete spinal block. This is, indeed, a new procedure in the diagnosis of spinal cord lesions and may prove of considerable aid. It certainly seems to have been of great value in the hands of Dr. Perryman and his associates. An interesting paper on *Alkali Halides X-ray Intensifying Screens* was given by Dr. Michel Ter-Pogossian, St. Louis, Missouri. Dr. Ter-Pogossian concluded from comparative studies with this type of screen and the commercial calcium tungstate screens of comparable detail that the potassium iodide screens are (1) approximately four times faster; (2) less sensitive to scattered radiation; and (3) of increased contrast in roentgenographic studies with iodinated contrast media.

As might be expected of a man so capable in radiologic techniques as Dr. Chamberlain, a program of his could not have been complete without including some paper along identical lines in which he himself made a notable contribution. So, the final paper on Friday morning was on the *Essentials of Good X-ray Film Processing* by Dr. George C. Henny and Dr. W. Edward Chamberlain, Philadelphia, Pennsylvania, an important subject dealing with a basic radiologic requirement.

The Instructional Courses, which for so long a time have been an essential part of the Annual Meeting of the American Roentgen Ray Society, were again given this year under the directorship of Dr. Harry M. Weber. As usual, the various courses attracted a large group of interested individuals. Dr. Weber had surrounded himself with a distinguished faculty for the Instructional Courses.

Adequate time was allowed for viewing the Scientific and Commercial Exhibits so that members and guests were able to study both. The Scientific Exhibits, collected by the Committee under the Chairmanship of Dr. William A. Evans, were not only numerous but intensively instructive. Dr. Evans and his committee have set a standard for such exhibits at the Los Angeles meeting which will be difficult for others to follow.

The Commercial Exhibits of this year's meeting were of exceptional quality and character, and there was ample room for displaying the exhibits. They attracted the attention of all those present at the meeting. Elsewhere in this issue of the JOURNAL will be found a more detailed description of the Commercial Exhibits and a list of the exhibitors.

While the scientific sessions form the primary interest of the annual meeting, this report would not be complete without

calling attention to the various social aspects which highlighted the Los Angeles meeting. The Society is greatly indebted to the Committee on Local Arrangements under the able chairmanship of Dr. Wilbur Bailey for the excellence of the social programs which they had arranged.

On Monday preceding the beginning of the meeting, the Annual Golf Tournament was held at the Wilshire Country Club for members of the Society and its guests. Competition was for the Willis F. Manges Trophy and for the Exhibitors' Trophy. The Tournament was followed by the Annual Golf Dinner at the same Club.

On Thursday evening, preceded by cocktails, the Annual Banquet was held in the beautiful Pacific ballroom of the Statler Hotel. At this time Dr. Chamberlain made the presentation of the annual awards to the scientific exhibitors, based on the most outstanding exhibits. Also, at the banquet Dr. Chamberlain introduced the President-Elect, Dr. Wendell G. Scott. The banquet was followed by most enjoyable entertainment and dancing.

For the visiting ladies a fine program was arranged by the Local Ladies Committee under the Chairmanship of Mrs. Wilbur Bailey, consisting of a Golf Widows' dinner, luncheon, and trips to various places of interest. Mrs. Bailey was assisted by Mrs. Lowell Goin and Mrs. Ross Golden, as co-chairwomen. To this Committee the Society is extremely grateful and extends its thanks.

To the Los Angeles Convention Bureau members, the Society expresses its appreciation for the efficient manner in which the registrations were carried out.

To the Management and Staff of the Statler Hotel, the Society has nothing but gratitude for the manner in which they carried out every detail of the arrangements made by the Local Committees and the Society's representative. Judged by the comments which were heard during and after the meeting, it is the belief of those attending that the Fifty-seventh Annual Meeting of the American Roentgen Ray Society was most outstanding and one which will be remembered for a long time.

We regret to announce the sudden death on October 17, 1956 of Dr. William A. Evans, a distinguished member of the American Roentgen Ray Society.

THE SCIENTIFIC EXHIBIT

The Scientific Exhibit of the Fifty-seventh Annual Meeting of the American Roentgen Ray Society, held at Hotel Statler, Los Angeles, California, September 25 to 28, 1956, which was arranged by the Committee on Scientific Exhibits under the Chairmanship of Dr. William A. Evans, Jr., was one of the largest and most successful in the Society's history. Subjects of unusual variety and of great timely interest were chosen by the many exhibitors to depict the most recent developments in the rapidly progressive science of radiology. The exhibits were placed adjacent to the room of the Scientific Assembly, affording the members and guests ample opportunity to visit them, a fact which possibly contributed to some extent in engendering increased attendance. The display of the exhibits themselves, however, was so outstanding that it is questionable whether anything could have diminished the great attention they had attracted. The Committee on Awards must have had the greatest difficulty in making the proper selection for the customarily given prizes. After thoughtful consideration one Silver Medal, one Bronze Medal and four Certificates of Merit were awarded.

Following are brief descriptions of the exhibits together with the awards which were made.

I. SILVER MEDAL. *Pulmonary Alveolar Microlithiasis; Another Esoteric Disease.* Merrill C. Sosman, M.D., Gerald Dodd, M.D., George U. Pillmore, M.D., and W. Duane Jones, M.D., The Peter Bent Brigham Hospital, Boston, Massachusetts. This exhibit consisted of roentgenograms of the chest of 19 cases of microlithiasis alveolaris pulmonum. Eleven cases have appeared in four families.

This is a relatively rare disease. Only 21 definite cases could be found in the world literature. These 21 cases were presented in a tabular form, and now the authors have added 19 new cases.

The condition is not due to any infection, occupation or tumor, but seems to be the result of abnormal biochemical reactions in otherwise normal pulmonary alveoli. The result is the deposition of minute calculi inside the alveoli. The new information presented by the exhibitors is that the disease occurs in families, presumably either on a hereditary or transmissible basis. They feel that the roentgenographic appearance is quite characteristic. The patients are usually free of symptoms for years, but eventually die either of pulmonary insufficiency or of cor pulmonale.

II. BRONZE MEDAL. *A Basis for Improved Roentgen Techniques.* William J. Tuddenham, M.D., M.Sc. (Med.), Hospital of the University of Pennsylvania, Philadelphia, Pennsylvania. The physiologic basis of roentgen image perception was graphically portrayed. Various problems of roentgen image visibility encountered in routine "film reading" were illustrated and solutions suggested by physiologic considerations were presented. The usefulness of the concepts of visual physiology (as opposed to purely physical principles) in the development of improved roentgenographic techniques was demonstrated with appropriate roentgenograms.

The conclusion was reached that the detection of a lesion depends on: (1) the projection of its image on the retina not on the roentgenographic image alone; (2) the brightness gradient across the image border not on contrast alone; (3) the selective recording of critical tissues not the indiscriminate recording of maximum anatomic detail.

Visual physiology provides the basis for rational development of improved roentgenographic and interpretative techniques.

CERTIFICATES OF MERIT

1. *Dose Distribution in Rotation Therapy; Effect of Field Size, Radiation Quality, and Target-Axis Distance.* Edith H. Quimby,

Sc.D., and Beverly S. Cohen, B.A., College of Physicians and Surgeons, Columbia University, New York, New York. A critical relationship in rotation therapy is the ratio of maximum skin dose to axis dose. The smaller this ratio, the less radiation is received outside the constantly irradiated region for a fixed axis dose. In this exhibit, values were presented for this ratio in the treatment of 360° rotation of typical lesions in head, thorax, and pelvis, when different combinations of field size, target-axis distance, and radiation quality were employed.

Field size will in general be selected so that the lesion is just covered. A series of suitable field sizes was included for each anatomic region. Radiation qualities were those of half-value layers 1.0, 2.0, 4.0, 8.0, and 15.0 mm. Cu (the last being Co^{60} radiation). Target-axis distances were 65 and 85 cm.

Three positions were considered for each lesion, one central, one displaced laterally, and one displaced anteriorly. For each lesion position the anatomic section was shown, with the relevant fields superimposed. Accompanying each section was a set of curves showing decrease in skin/axis dose ratio with improvement in radiation quality.

Conclusions were drawn regarding possibilities and limitations of rotation therapy in the 200–250 kv. range, and improvements to be achieved with better qualities of radiation.

2. *Pneumoperitoneography in Strangulating Intestinal Obstruction.* J. F. Perry, M.D., S. C. Von Drashek, M.D., O. H. Wangensteen, M.D., and C. M. Nice, M.D., University of Minnesota, Minneapolis, Minnesota. The early recognition of strangulating intestinal obstruction is imperative but unfortunately often difficult. A number of diagnositc approaches were tried in the dog laboratory, of which roentgenograms after the induction of pneumoperitoneum proved the most satisfactory. The technique is simple and quick; the demonstration of enlarged fluid-filled closed loops is vivid and easily convincing to the surgeon.

This exhibit included a summary of experimental work, a description of technique and a discussion of a number of representative clinical cases.

3. *Radiotherapy of Carcinoma of the Accessory Nasal Sinuses; with Consideration of an Intracavitary Multiple Source Treatment Procedure.* Paul M. St. Aubin, M.D., Edward W. Webster, Ph.D., and Milford D. Schulz, M.D., Massachusetts General Hospital, Boston, Massachusetts. This exhibit demonstrated various procedures in the treatment of carcinoma of the nasal sinuses, including surgical methods, internal beam therapy (multiportal and rotation), and methods of intracavitary treatment. Emphasis was placed on a multiple source packing procedure and this was compared with other intracavitary methods as a supplement to surgery and internal beam therapy.

Wax models were used to illustrate the various procedures.

The exhibit was based on experience gained with 130 cases treated between 1930 and 1950. The results and factors of prognostic value were also given.

4. *Gamma Radioscopy; Collimators for Scanning the Body for Gamma Tagged Deposits.* R. R. Newell, M.D., Stanford University School of Medicine, San Francisco, California. Collimator used with scintillation counter should be designed for a particular purpose. Cylindrical and conical and multiple channel collimators were discussed by means of charts. The uses and shortcomings of wide and narrow scanning "beams" were shown. Techniques and program of scanning were illustrated for discovery and mapping of a gamma active source. Some collimators were shown in action.

Other Excellent Exhibits Were the Following:

Is Radium Still Necessary? An Exhibit Featuring the Values of Radium, in Whole or in Part, in the Treatment of Cancer. Douglas Quick, M.B. (Tor.), and Jeanne

D. Richmond, A.B., The Roosevelt Hospital (Exhibit from The Janeway Clinic), New York, New York. Radium, a naturally radioactive element, was the first source of gamma radiation used in cancer therapy. High energy gamma radiation continues to be the most effective quality of radiation with a substantial background of experience in cancer therapy. Radium is the most stable source of such gamma therapy.

Radium lends itself admirably to many combinations, in cooperative effort with other sources of radiation, or with surgery, or with both.

The material for this exhibit demonstrated various ways in which radium may be used to aid in the treatment of cancer. Radium therapy was shown as (a) an accessory aid, and where its use is a treatment of election, such as intracavitary sources employed in carcinoma of the maxillary antrum, combined with external therapy and surgery, and in carcinoma of the uterine cervix, combined with external therapy, also in head and neck problems; (b) an adjunct to other therapy—either roentgen irradiation or surgery; and (c) the total agent used, resulting in unique advantages that are for the most part not possible with other sources of radiation used in cancer therapy.

On the equipment side, it was shown that the radium beam therapy is worthy of study. It represents, in principle, multiple fixed beam therapy with maximum accuracy.

Intraventricular Epidermoid. Arthur E. Childe, M.D., Winnipeg General Hospital, Winnipeg, Manitoba. It is generally agreed that intraventricular epidermoids when they are situated in the lateral ventricles give rise to a rather diagnostic pneumographic appearance.

This exhibit illustrated the findings in a thirty-two year old male in whom there was a large epidermoid involving the right lateral ventricle. Craniotomy confirmed the presence of a large intraventricular epidermoid.

Dissecting Aneurysm of the Thoracic Aorta. Stanley M. Wyman, M.D., Massachusetts General Hospital, Boston, Massachusetts. Dissecting aneurysm of the thoracic aorta usually presents with quite typical clinical findings but not infrequently there may be no signs or symptoms to suggest its presence. The dissection in the wall of the vessel characteristically produces enlargement of the outside diameter of the aorta, which can be recognized by roentgenologic examination. In the classical case this produces a widened, nodular aorta. Angiocardiography may demonstrate narrowing of the lumen with thickening of the wall. The most conclusive roentgenologic finding by conventional examination is the demonstration of an increase in the width of the vessel in a subsequent examination. The radiologist may make the diagnosis in the typical case without a clinical history.

Parosteal Osteogenic Sarcoma. G. M. Stevens, M.D., D. G. Pugh, M.D., and D. C. Dahlin, M.D., Mayo Clinic, Rochester, Minnesota. Examples of parosteal osteogenic sarcoma were shown and the pathologic and roentgenologic features discussed. The almost invariable recurrence of the tumor after attempts at local excision was made evident. Although this tumor has a deceiving appearance of benignancy, its malignant nature was demonstrated.

Patent Ductus Arteriosus; a Teaching Exhibit. Charles T. Dotter, M.D., Herbert E. Griswold, M.D., Louis H. Frische, M.D., and Masao Tamaki, M.D., University of Oregon Medical School, Portland, Oregon. The manifestations and prognosis of patent ductus arteriosus vary markedly depending upon which of four reasonable distinct pathophysiologic situations exists. In general, the direction and volume of shunt depend upon the relative pressure in pulmonary and systemic arteries. Patent ductus arteriosus in its simple form can be completely cured surgically with negligible risk. Procrastination in establishing the diagnosis or in referring such patients for

surgery may cost their lives since secondary reversal of shunt is associated with a very poor prognosis.

LogEtronography. Elmer G. St. John, M.D., and Dwin R. Craig, B.S., Binghamton, New York. The LogEtron is defined as a scanning, servo-modulated light source for electronic exposure control in photographic printing. It is the only known automatic means for producing individual and uniform exposure of very small areas having random distribution and range of density variations. Those familiar with photography will recognize the above as the definition for the automatic "dodging," the need for which is greatest in the reproduction of roentgenograms.

It is well known that the double emulsion used in roentgenographic films produces a density range which ordinarily refuses to be compressed to that of single emulsion materials without (a) insufferable loss of detail contrast, or (b) total loss of detail in both "highlight" and "shadow" regions. However, with automatic dodging, detail at a high contrast level can be reproduced (even enhanced) in all regions by reducing the highlight, shadow, and mid-tones to a common level. In roentgenograms, this means preservation of vital detail information at the expense of relatively unimportant information pertaining to gross variations in body thickness, relative radiopacity of bone and soft tisue, etc. This intentional loss of trivial information, in order to transfer maximum detail information, represents a clear distinction between LogEtronic reproduction and the usual "faithful reproduction."

Consequently, it is now possible to (a) produce automatically paper prints ideally suited for publication; (b) copy roentgenograms on paper or film with improved detail visualization for teaching; and (c) produce LogEgram transparencies, having higher detail contrast than the original, as aid to diagnosis.

Cardiac Ventriculography; Direct Transthoracic Needle Puncture Opacification of the Left (or Right) Ventricle. J. Stauffer Lehman, M.D., Benjamin G. Musser, M.D., and Harry D. Lykens, M.D., The Hahnemann Medical College and Hospital of Philadelphia, Philadelphia, Pennsylvania. Direct needle puncture opacification of the left (or right) ventricle of the heart is a relatively new procedure. The details of technique, pressure recording during the procedure of ventricular puncture, continuous electrocardiographic recordings, actual film opacification studies of some of the lesions of the ventricles and valves and of the aorta, and the hazards and complications of the procedure were displayed.

Laryngography; Contrast Study of the Larynx and Pharynx. William E. Powers, M.D., Harry H. McGee, M.D. and William B. Seaman, M.D., Mallinckrodt Institute of Radiology, St. Louis, Missouri. Laryngography is a method of contrast study of the larynx and pharynx utilizing topical anesthesia and a nontoxic contrast medium. The normal and abnormal anatomy and physiology have been studied with the correlation with direct and indirect visual examination and surgical specimens.

Calcification in Solitary Peripheral Bronchogenic Carcinomas; Roentgenographic Demonstration in the Excised Specimen. Mathew E. O'Keefe, Jr., M.D., and C. Allen Good, M.D., Mayo Clinic & Mayo Foundation for Medical Education & Research, Rochester, Minnesota. Roentgenograms were made of the excised specimen in 207 cases of solitary pulmonary nodule. The demonstration of calcium within a nodule was confirmed by microscopic examination using specific staining techniques. The presence of calcium within a nodule was correlated to its appearance on the preoperative roentgenograms. It was found that calcium was present in sufficient quantity to cast a shadow on the roentgenogram of the specimen more often than it could be demonstrated preoperatively. It was found, also, that 15.8 per cent of bronchogenic carcinomas, 14.3 per cent of bronchial adenomas and 10 per cent of metastatic nodules in this group of cases were calcified.

Dysplasia Epiphysialis Hemimelica. Harold Fulton, M.D., Robert Willis, M.D., and William A. Evans, M.D., Children's Hospital of Michigan and Harper Hospital, Detroit, Michigan. Dysplasia epiphysialis hemimelica is a congenital epiphysial dysplasia which characteristically affects the medial or lateral portion of the epiphyses of one extremity. The roentgen appearance is diagnostic. Several examples of this entity were displayed in conjunction with clinical features, operative findings and pathologic specimens.

Roentgen Manifestations of Torulosis (Cryptococcosis). George Jacobson, M.D., and John N. Wolfe, M.D., Los Angeles County Hospital and University of Southern California, Los Angeles, California. A summary was given of 21 proved cases of torulosis including brief descriptions of pathologic and clinical findings. Representative roentgenograms of the various types of pulmonary and osseous lesions were presented.

Motor Phenomena in the Distal Esophagus; the Inferior Esophageal Sphincter, the Vestibule, the Cardiac Sphincter. Bernard S. Wolf, M.D., Richard H. Marshak, M.D., Max L. Som, M.D., and Sigmund A. Brahms, M.D., The Mount Sinai Hospital, New York, New York. This exhibit demonstrated physiologic contractile phenomena in the distal esophagus which may be correlated with the anatomic description of Lerche. Observations were based primarily on cases with minimal hiatal herniation and motion picture studies with the image intensifier.

(1) Coccidioidomycosis in Children: (2) Coccidioidal Infection of Bone. John W. Birsner, M.D., William H. Leask, M.D., Ben M. Dahle, M.D., and Joseph L. Cummins, M.D., Kern General Hospital, Bakersfield, California. (1) Representative roentgenograms were shown to demonstrate usual aspects and progress of coccidioidal infection in children. (2) Osseous involvement was observed in southern San Joaquin Valley. The order of bone involvement was (a) vertebrae, (b) extremities, (c) skull and (d) sternum.

Radio Cardiography. Walter Francke, M.D., St. Vincent Hospital, Billings, Montana. By means of a scintillating probe, count rate meter and recorder, radiocardiograms were obtained from 50 patients. These curves, when plotted, yielded the following information: circulation time, pulmonary blood flow, total blood volume, and stroke volume. Only two vena punctures were required. The clinical applications were listed.

Kilocurie Revolving Cobalt 60 Unit for Radiation Therapy. Lester S. Skaggs, Ph.D., and Lawrence H. Lanzl, Ph.D., Argonne Cancer Research Hospital, University of Chicago, Chicago, Illinois. This exhibit showed by means of radiation measurements the advantages of using uranium shielding and high specific activity sources of small cross section in the design of kilocurie revolving cobalt 60 therapy units.

The use of uranium results in an appreciable reduction of space requirements and a great reduction in weight over that required by lead. A source of small cross section of high specific activity produces a minimal penumbra which is important for a revolving unit where the collimator is placed some distance from the patient's skin.

Xeroradiographic Study of Bone. Crawford Campbell, M.D., John F. Roach, M.D., and Andre Grisolia, M.D., Albany Medical College, Albany, New York. A comparative study of several bone tumors by means of xeroradiography, conventional roentgenography and photography of the gross sections was presented.

The image obtained of the sections of bone had much the same appearance as a standard roentgenogram except that detail and contrast gradation were superior.

Unusual Lung Nodules; Lung Nodules Having Both Granuloma and Neoplasm Characteristics. Charles P. Oderr, M.D., and Philip Pizzolato, M.D., Veterans Administration Hospital #5235, New Orleans, Louisiana. This exhibit showed a peculiar nodular lung disease in a young white male which caused a slow respiratory death. The first roentgenogram was made

at the age of nineteen and death occurred at the age of twenty-three. At autopsy, numerous gray nodules exhibiting proliferation of large pale cells peripherally, and necrosis and hyalinization centrally were found. Photographic enlargements of beryllium window roentgenograms of dried expanded lung sections and enlargements of microphotographs were shown to demonstrate the peculiarities of this disease and the difficulties of classifying it.

The most probable diagnosis was alveolar cell neoplasm, but a strong resemblance to reticuloendothelial granuloma existed.

The Clinical Value of Cephalopelvimetry; Analysis of 350 Roentgen Studies. Gerhart S. Schwarz, M.D., Presbyterian Hospital, New York, New York. Three hundred and fifty roentgen cephalopelvimetries (by the Ball method) performed on ward patients because of clinical suspicion of disproportion were analyzed and the obstetrical outcome recorded.

The roentgen diagnoses were divided according to cephalopelvic volume difference into three classes: (1) no disproportion, (2) borderline disproportion and (3) high disproportion.

The results were shown in round figures on flow charts which illustrated the fate of all 2,300 pregnant women who entered the Obstetrical Ward Service of Sloane Hospital for Women in the Columbia-Presbyterian Medical Center for delivery during the period of observation.

A detailed correlation of measurements to obstetrical outcome was given on graphs containing all abnormal and a comparable number of normal cases. Inlet and midpelvis were analyzed separately.

The conclusion was reached that cephalopelvimetry is clinically useful in that it is capable of reducing the number of clinically doubtful cases to one-fifth of its original value. It provided a definite and correct answer in four-fifths of these cases.

Chordoma—Variable Features in Diagnosis. Charles M. Greenwald, M.D., Thomas F. Meaney, M.D., and C. Robert Hughes, M.D., Cleveland Clinic, Cleveland, Ohio. Chordomas are uncommon neoplasms of notochordal origin which may occur anywhere along the cerebrospinal axis. Examples of chordomas in the cranial, vertebral, and sacrococcygeal locations were shown. Emphasis was given the vertebral lesion which is least common. Roentgen findings were not diagnostic at any level, and were most variable in the vertebral chordoma. A differential diagnosis was presented which varies with the level of origin.

Studies of Esophageal Varices Before and After Portacaval Shunts. John A. Evans, M.D., The New York Hospital—Cornell Medical Center, New York, New York. This exhibit concerned a group of 68 patients who had roentgenologic examinations for esophageal varices before and after a venous shunt for portal hypertension. Fifty-seven patients had a portacaval shunt, 9 patients a splenorenal shunt and 2 patients a shunt utilizing smaller mesenteric veins.

The ability to obtain a good mucosal relief pattern of the distal esophagus is the indispensable condition for a satisfactory examination. To accomplish this, fluoroscopy, spot filming and a liberal quantity of patience are necessary. Each case must be individualized to obtain best results.

Colonic Polyps—Clinical Significance and Roentgen Diagnosis. Leo S. Figiel, M.D., Steven J. Figiel, M.D., and Fred K. Wietersen, M.D., Grace Hospital, Detroit, Michigan. Most polyps 5 mm. or over in size excluding those in the distal 20 cm. of the colon can be accurately detected by a combined roentgenographic approach, providing the patient is properly prepared.

More accurate and frequent detection of polyps, especially multiple polyps, has resulted in a need for clinical re-appraisal of the significance of the colonic polyp, as well as of surgical techniques used in the treatment of these lesions.

The dictum "Every polyp is precancerous and should be removed" must be reevaluated in view of the large number of small asymptomatic polyps being detected in the older age group. Since accurate evaluation of the size and shape of most

colonic polyps is possible with the authors' techniques, they recommend that the smaller asymptomatic polyps in the older age group be studied by roentgenographic follow-up for any change in size. Immediate surgery is not necessarily indicated.

The Clinical Use of a Mechanical Isodose Calculator in Rotation Therapy. R. J. Shalek, Ph.D., V. A. Sampiere, and G. H. Fletcher, M.D., The University of Texas, M. D. Anderson Hospital & Tumor Institute, Houston, Texas. Complete volume dose distributions are just as essential in rotational therapy as in stationary portal therapy in order to insure (1) irradiation of the whole tumor, (2) determination of minimum tumor dose, (3) correlation of clinical reactions with dose, and (4) protection of vital structures.

A mechanical calculator for the rapid calculation of isodose patterns in arc and long axis moving beam therapy was shown. The radiation dose to the center of rotation can be calculated in one minute and a complete isodose pattern prepared in one and one-half hours. Typical rotational patterns were compared with fixed port patterns.

Complete volume distributions were demonstrated and correlated with clinical observations for the following regions: (1) nasopharynx, (2) oral cavity, (3) mediastinum, and (4) pelvis.

Mold Technology in Radiation Therapy of Cancer and Allied Diseases. Bernard Roswit, M.D., Sol M. Unger, M.D., Stanley J. Malsky, M.A., M.Sc., Cyprian B. Reid, B.Sc., and Louis Maddalone, Veterans Administration Hospital, Bronx, New York. Mold technology provides the means for greater skill and greater precision in radiation treatment of malignant disease. This exhibit illustrated mold technology and treatment planning, patient immobilization, bolus application, beam orientation, radiation protection, radium therapy, and research and education. Wider utilization of these techniques will serve to enhance the probability for cure and minimize the risk of serious complications. Mold technology is clinically practicable in any radiotherapy service, private or public, large or small.

Mediastinal Tumors. W. Emory Burnett, M.D., George P. Rosemond, M.D., R. M. Bucher, M.D., R. R. Tyson, M.D., and J. P. Moore, M.D., Temple University Hospital and School of Medicine, Philadelphia, Pennsylvania. Twelve cases of mediastinal tumors were exhibited to show diagnostic points in most of the usual types neoplasms. There was also a swing wing display to test diagnostic acumen.

Bronchial Adenoma—Therapeutic Problem. Oscar H. Friedman, M.D., Coleman B. Rabin, M.D., and Stuart I. Gurman, M.D., The Mount Sinai Hospital, New York, New York. This exhibit consisted of a demonstration of the pathologic, clinical and roentgenologic features of 88 cases, including 4 cases that showed distant metastases. Criteria for the differentiation from bronchial carcinoma were demonstrated. The incidence of the purely endobronchial form and results of bronchoscopic and surgical treatment were shown.

Educational Exhibit. American Society of X-ray Technicians and American Registry of X-ray Technicians, Arlington Heights, Illinois. This was a promotional exhibit outlining achievements and future planning of the American Society of X-ray Technicians and the American Registry of X-ray Technicians.

THE COMMERCIAL EXHIBIT

The Commercial Exhibit of the Fifty-seventh Annual Meeting of the American Roentgen Ray Society, held in Los Angeles, California, September 25 to 28, 1956, was outstanding in every respect. The ultra-modern facilities of the beautiful Statler Hotel, the location of the spacious Exhibit Halls within convenient distance of the meeting room and other activities of the Society, the very attractive over-all arrangement and, most important, the unexcelled quality of the individual displays were all pleasant features which undoubtedly will make this meeting long to be remembered. The Exhibitors were amply rewarded for their untiring efforts by the unusually great interest their exhibits created throughout the entire meeting. The Society wishes to thank them most sincerely for their notable contribution to the great success of the meeting.

The following is a list of the firms which participated in the Commerical Exhibit:

Abbott Laboratories, North Chicago, Illinois; Ansco, Binghamton, New York; Atomic Energy of Canada Limited, Ottawa, Ontario, Canada; Automatic Seriograph Corporation, College Park, Maryland; Barnes-Hind Barium Products Company, Sunnyvale, California; Bell-Craig, Inc., New York, New York; Blair X-ray Inc., Los Angeles, California; Carr Corporation, Culver City, California; Dunlee Corporation, Chicago, Illinois; E. I du Pont de Nemours & Company, Inc., Wilmington, Delaware; Eastman Kodak Company, Rochester, New York; Encyclopaedia Britannica, Inc., Los Angeles, California; Eureka X-Ray Tube Corporation, Chicago, Illinois; Fairchild Camera and Instrument Corporation, Jamaica, New York; H. G. Fischer & Company, Franklin Park, Illinois; E. Fougera & Company, Inc., New York, New York; Franklin X-Ray Corporation, Philadelphia, Pennsylvania; Friez Instrument Division, Bendix Aviation Corporation, Baltimore, Maryland; General Electric Company, Milwaukee, Wisconsin; Halsey X-Ray Products, Inc., Brookyln, New York; Keleket X-Ray Corporation, Boston, Massachusetts; Lea & Febiger, Philadelphia, Pennsylvania; Leishman X-Ray Engineering Company, Los Angeles, California; LogEtronics Inc., Alexandria, Virginia; Low X-Ray Film Corporation, New York; Machlett Laboratories, Inc., Springdale, Connecticut; Mallinckrodt Chemical Works, St. Louis, Missouri; F. Mattern Manufacturing Company, Chicago, Illinois; Micro X-Ray Recorder, Inc., Chicago, Illinois; Miles Reproducer Company, Inc., New York, New York; North American Philips Company, Inc., New York, New York; Nuclear Instrument and Chemical Corporation, Los Angeles, California; Pako Corporation, Minneapolis, Minnesota; Physicians' Technical Equipment Company, Milwaukee, Wisconsin; Picker X-Ray Corporation, White Plains, New York; Profexray, Inc., Maywood, Illinois; Reed-Curtis Nuclear Industries, Plaza del Ray, California; Schering Corporation, Bloomfield, New Jersey; Schick X-Ray Company, Inc., Chicago, Illinois; Frank Scholz X-Ray Corporation, Boston, Massachusetts; Standard X-Ray Company, Chicago, Illinois; Charles C Thomas, Publisher, Springfield, Illinois; United States Radium Corporation, New York, New York; Victoreen Instrument Company, Cleveland, Ohio; Westinghouse Electric Corporation, Pittsburgh, Pennsylvania; Winthrop Laboratories, New York, New York.

ABSTRACTS OF RADIOLOGICAL LITERATURE

Department Editor: T. Leucutia, M.D., Harper Hospital, Detroit 1, Michigan

INDEX TO ABSTRACTS

ROENTGEN DIAGNOSIS

Head

Bushe, K. A., Gaca, A., and Poppe, H.: Cerebral simultaneous serial angiography on 70×70 mm. frame..... 1182
Freundlich, E., Beller, A. J., and Berman, S.: Subdural hematoma in infancy..... 1182
Mokrohisky, J. F., Paul, R. E., Lin, P. M., and Stauffer, H. M.: The diagnostic importance of normal variants in deep cerebral phlebography; with special emphasis on the true and false "venous angles of the brain" and evaluation of venous angle measurements..... 1182
Silver, C. M., Simon, S. D., and Savastano, A. A.: Meniscus injuries of the temporomandibular joint..... 1183
Wang, C. C., and Robbins, L. L.: Cushing's disease: Its roentgenographic findings..... 1183

Neck and Chest

Höffken, W.: Aspergilloma of the lung..... 1184
Good, C. A., and McDonald, J. R.: Roentgenologic evidence of calcification in a peripheral bronchogenic carcinoma..... 1184
Birzle, H.: Contribution to bronchographic technique..... 1184
Lissner, J.: Electrokymography in pathologic densities of the mediastinum and in the proximity of the hilus..... 1185
Petersen, O.: Rib notching following the Blalock-Taussig operation..... 1185

Abdomen

Knoefel, P. K., David, L. A., and Pilla, L. A.: Agglomeration of barium sulfate and roentgen visualization of the gastric mucosa. 1185
Palmer, E. D.: Achalasia: Anatomy of the cardia as it relates to the regional pathophysiology..... 1185
Pfeiffer, J.: Pharmacoradiography of the stomach..... 1186
Davis, J. G., and Adams, D. B.: The roentgen findings in gastric leiomyomas and leiomyosarcomas..... 1186
Rogers, J. V., Jr., and Adams, E. K.: Gastric lipoma; case report..... 1187
Teplick, J. G.: Duodenal loop changes in posterior penetration of duodenal ulcer..... 1187
Cimmino, C. V.: Experiences with the upright fluoroscopic spot-film examination of the gallbladder..... 1187
Aldridge, N. H.: Combined intravenous cholecystography and pyelography..... 1187
Mitchell, D. J.: Basic combined cholecystangiography..... 1188
H:son Holmdahl, K.: Cholecystography during lactation..... 1188
Lee, C. M., Jr., Newstedt, J. R., and Siddall, H. S.: Large abdominal tumors of childhood (other than Wilms' tumor or neuroblastoma)..... 1188

Gynecology and Obstetrics

Holm, O. F.: Occurrence of free gas in the fetus in cases of intra-uterine death..... 1188
Wiltse, L. L., and Frantz, C. H.: Nonsuppurative osteitis pubis in the female.... 1189

Genitourinary System

Lentino, W., Zeitel, B. E., Jacobson, H. G., and Poppel, M. H.: Intravenously given urographic mediums; comparative study of eight hundred cases..... 1189
Green, B., and Sowerbutts, J. G.: A comparative study of the value of sodium acetrizoate (diaginol) 50 per cent and sodium diatrizoate (hypaque) 45 per cent in intravenous urography..... 1190
Liming, R. W., and Youngs, F. J.: Metastatic vertebral osteomyelitis following prostatic surgery..... 1190
Close, M. B., Peterson, C. A., and Johnson, R. P.: Bilateral embryoma of the kidney: patient alive and well three years after treatment..... 1190

Skeletal System

Bakwin, H.: Multiple skeletal lesions in young children due to trauma..... 1190
Willich, E.: Subepiphyseal linear translucencies of early infancy with special consideration of the osteomyelitis..... 1191
Schultz, E. H., Jr., Levy, R. W., and Russo, P. E.: Agenesis of the odontoid process.... 1191

Fenton, R. L.: The naviculo-capitate fracture syndrome 1191
Avin, J.: The male Turner syndrome 1191
Finby, N., Jacobson, H. G., and Poppel, M. H.: Idiopathic coxa vara in childhood .. 1192
Balzarini, E., and Pompili, G.: Technique and radiographic anatomy of the normal sternum 1192
Duncan, J. G.: Radiological manifestations of hyperparathyroidism 1192
Bolen, J. G.: Diabetic Charcot joints 1193

Blood and Lymph System

Saltz, N. J., Luttwak, E. M., Schwartz, A., and Goldberg, G. M.: Danger of aortography in the localization of pheochromocytoma 1193
Enselberg, C. D.: The clinical picture of aneurysm of the abdominal aorta 1193
Murphy, T. O., and Margulis, A. R.: Roentgenographic manifestations of congenital peripheral arteriovenous communications .. 1193
Helander, C. G., and Lindbom, Å.: Roentgen examination of the inferior vena cava in retroperitoneal expanding processes 1194

General

Stanford, R. W., and Hills, T. H.: An advance in x-ray film processing 1194

RADIATION THERAPY

Fowler, F. D., Alexander, E., Jr., and Davis, C. H., Jr.: Pinealoma with metastases in the central nervous system; a rationale of treatment 1195
Ross, D. E.: Cancer of the thyroid gland 1195
Uhlmann, E. M.: Cancer of the thyroid and irradiation 1196
Garland, L. H., and Sisson, M. A.: The results of radiotherapy of bronchial cancer ... 1196

ROENTGEN DIAGNOSIS

Head

Bushe, K. A., Gaca, A., and Poppe, H. Zerebrale Simultan-Serien-Angiographie im 70 ×70 mm. Format (Erfahrungen mit der Odelca-Kamera). (Cerebral simultaneous serial angiography on 70×70 mm. frame [experiences with the Odelca-Camera].) *Fortschr. a. d. Geb. d. Röntgenstrahlen u. d. Nuklearmedizin*, May, 1956, *84*, 633–643. (Address: Chirurg. Univ.-Klinik, Gosslerstrasse 10, Göttingen, Germany.)

After a short historical review of cerebral arteriography, the authors discuss the various devices, which have been developed to make several exposures at short intervals, for the visualization of the different arterial and venous filling phases of the cerebral vessels. They mention the direct method requiring large films as well as the indirect method of photofluorography using only very small film sizes.

They employed the Odelca-Camera, which was first shown by A. Bouwers at the International Roentgen-Congress in London, in 1950. This camera with a special "Rapidix-cassette" permits taking 5 to 6 pictures a second on 70×70 mm. films, with a maximum of 40 to 45 pictures on one film roll.

Bouwers uses the principle of the optical mirror, which, with a speed of, 1:0.75, is faster than any lens and has an excellent resolving power.

Three illustrations show the Odelca-Camera with a patient in horizontal, 45° and vertical positions. The arrangement of both roentgen tubes and of the photofluorographic units is well illustrated.

Three series of cerebral arteriograms include—anteroposterior and lateral films, exposed at short intervals after the injection. Even in these reproductions, details are well shown.

The authors believe that this method of serial arteriography in two planes using the 70×70 mm. film size is especially suitable for the demonstration of the cerebral vessels. The particular advantages of the method are based on the possibility of showing all phases of the cerebral circulation in two planes, vertical to each other, with a single injection of contrast medium of not more than 8 to 10 cc. This small amount of contrast medium minimizes secondary blood vessel reactions with subsequent cerebral edema, and the cerebral arteriography becomes a less harmful diagnostic procedure.—*Hans Lewin, M.D.*

Freundlich, Emil, Beller, Aaron J., and Berman, Shimon. Subdural hematoma in infancy. *A.M.A. J. Dis. Child.*, June, 1956, *91*, 608–613. (From: Department of Pediatrics and the Department of Neurosurgery, Hadassah Hebrew University Hospital, Jerusalem, Israel.)

The authors analized 19 cases of subdural hematoma in infancy with more than 50 per cent of these cases seen between four and six months of age. The presenting features included head enlargement, anemia, retardation, fever, dehydration, malnutrition, bulging fontanel, convulsions, and vomiting. The most outstanding sign was enlargement of the head particularly in the biparietal diameter. In 14 of the 19 cases, suspicion of intracranial pathology was aroused because of this sign. An abnormal electroencephalographic tracing should contribute to the indications for diagnostic tap, with all 11 cases in which an EEG was performed showing abnormality.

A history of trauma was elicited in only 2 cases with 2 others having had a difficult delivery. Other possible etiologic factors in infantile subdural hematoma besides trauma are discussed. The authors were not able to confirm the finding of subdural effusion as a result of meningitis. In their 4 cases with meningitis, the hematoma was considered to antedate the infection. In children with dehydration and malnutrition, it is considered extremely difficult to decide whether these states are the cause or the result of hematoma. Interference with blood coagulation is probably an important contributing factor, and iatrogenic subdural hematoma may exist as the result of subdural tap especially in children with a bleeding tendency.

In only 3 cases was the hematoma unilateral, and in the remaining 16 it was bilateral. Surgery consisted of wide excision of both the inner and outer membranes of the hematoma after repeated subdural taps to decrease intracranial pressure gradually. Follow-up study revealed satisfactory psychomotor development in those children in which the brain expanded immediately after removal of the hematoma membranes, whereas when the brain failed to expand and remained atrophic there was retarded development.

Early diagnosis is desirable, as a poor surgical result is often due to delay in diagnosis.—*Bisamai Aramsri, M.D.*

Mokrohisky, John F., Paul, Robert E., Lin, Paul M., and Stauffer, Herbert M. The diagnostic importance of normal variants in deep cerebral phlebography; with special emphasis on the true and false "venous angles of the brain" and evaluation of venous angle measurements. *Radiology*, July, 1956, *67*, 34–47. (Address: J. F. Mokrohisky, Lourdes Hospital, 169 Riverside Dr., Binghamton, N. Y.)

The anatomy and normal range of variation of the deep cerebral veins and dural sinuses are described in this article which is based on a series of 400 cerebral angiograms obtained with the Chamberlain biplane, stereoscopic, rapid-sequence angiographic

unit. The value of demonstrating the deep cerebral veins angiographically, as an aid in localizing space-taking intracranial lesions, has been well established. The localization of the foramen of Monro through visualization of the characteristic vein coursing through it is of particular importance. This vein is formed by the junction of the striothalamic with the internal cerebral vein and the point at which the two veins join has been called the "venous angle of the brain."

The site of the foramen of Monro is indicated by the true "venous angle of the brain." A chart similar to the pineal chart of Vastine and Kinney has been devised by one of the authors for orientation of the venous angle. Using this chart the venous angle was found to be displaced outside the limiting lines set for normal variants in 37 per cent of the tumor cases.

Normal variants or tributaries of the internal cerebral vein occur in a significant percentage of cases and result in a false "venous angle of the brain." These variants may be mistaken for abnormal displacement of the venous angle and result in false localization of the foramen of Monro. Important points in recognizing this false "venous angle of the brain" are discussed.

On the anteroposterior phlebogram displacement of the venous angle, or internal cerebral vein alone to the opposite side a distance of only a few millimeters can be regarded as pathologic. The exclusive finding of displacement or distortion of these structures on the lateral phlebogram, however, must be interpreted with caution. The deep cerebral veins have limitations in diagnosis due to their wide range of normal variation.—*Harold C. Hamilton, M.D.*

Silver, Caroll M., Simon, Stanley D., and Savastano, Americo A. Meniscus injuries of the temporomandibular joint. *J. Bone & Joint Surg.*, June, 1956, *38-A*, 541–552. (From: Orthopaedic Services of the Rhode Island Hospital and Miriam Hospital, Providence, Rhode Island.)

The articular disk (meniscus) of the temporomandibular joint is a dense fibrous band separating the mandibular condyle and temporal fossa. It attaches to the posterior and anterior joint capsule serving with the latter as the site of insertion of the external pterygoid muscle. Sudden or forceful contraction of the muscle may detach the posterior attachment and draw the meniscus forward to lodge anterior to the condyle where it forms a mechanical block.

Malocclusion is believed to be the predominant predisposing factor with a history of recent wide opening of the mouth (yawning, etc.) immediately preceeding initial symptoms in many patients. Direct trauma is occasionally the precipitating cause.

Symptoms include pain, snapping, crepitation and locking, the latter almost invariably occurring when the mouth is closed. Tenderness, limited opening and deviation of the jaw toward the affected side are usual clinical findings.

Roentgenographically there is definite restriction of the normal forward condylar movement in the open mouth view. In severe cases, there may be bilateral fixation. The absence of arthritic, neoplastic, or traumatic changes on the roentgenogram points to the possibility of a displaced meniscus.

However, conservative measures of heat, sedation, avoidance of mastication, bite correction and hydrocortone injections relieve most patients with symptomatology of this nature. If the jaw is locked, or the distress persistent despite other adequate measures, surgical exploration and excision of the damaged meniscus is indicated.

Forty-four cases requiring such surgery are presented, with detailed description of the operative procedure. The most common findings were forward displacement of the meniscus, fringing of its undersurface and, microscopically, round cell infiltration and fibrous degeneration.

Periodic follow-up studies, including comparison films, have indicated uniformly good function and no demonstrable joint changes in periods up to five years.—*Dale W. Undem, M.D.*

Wang, C. C., and Robbins, Laurence L. Cushing's disease: Its roentgenographic findings. *Radiology*, July, 1956, *67*, 17–25. (Address: C. C. Wang, Department of Radiology, Massachusetts General Hospital, Boston 14, Mass.)

The authors present the roentgenographic findings of Cushing's disease as studied in 38 patients seen at the Massachusetts General Hospital since 1935. These can be divided into 2 categories: changes in bones and changes in soft tissues; they appear to be closely related to the severity and duration of the disease.

Cushing's disease affects the bones of the entire skeleton. The process is a generalized osteoporosis, particularly evident in the skull, spine, ribs, pelvis, and to a lesser extent the extremities. Bone changes are believed to be due to a disturbance of protein metabolism leading to insufficient tissue repair and to lack of bony matrix formation and calcium deposition.

In the mildest form, osteoporosis of the spine is manifest as increased transparency, with loss of the trabecular pattern of the vertebral bodies. Marked osteoporosis results in fractures which are characterized by: (a) wedging of the vertebrae; (b) anterior buckling or slight bulging of the mid-anterior surface of the vertebral bodies; (c) isolated crush fracture of one or more vertebrae; and (d) expansion of vertebral disks into the adjacent bones, with multiple compression fractures. In the extreme degree, the "fish-bone" vertebra may be found.

Osteoporosis is usually less marked and less readily detected in the pelvic bones than in the spine. Of 35 roentgenograms of the pelvis, 15 revealed slight to moderate decalcification, and in 3 there was marked osteoporosis associated with spontaneous fractures. Osteoporosis of the ribs was manifested by increased radiolucency, coarsening of the bony trabeculae and fractures. Multiple rib fractures, some showing evidence of repair, were found in 14 patients. Osteoporosis was present in all except 4 of the 22 skulls examined. In most instances there were peculiar punctate, sandpaper-like, granular rarefactions. In others there was diffuse mottled decalcification. In all cases examined, the sella turcica appeared normal in size, with a single exception, in which there was questionable enlargement. Osteoporosis of the bones of the extremities was less marked than that seen in the skull, spine and pelvis.

Enlargement of the adrenal gland may be demonstrated by appropriate techniques, including plain roentgenography of the upper abdomen, laminagraphy, abdominal aortography, and retroperitoneal air insufflation. Its enlargement may represent: (a) carcinoma, producing a fairly large soft tissue mass; (b) an adenoma of lesser size; and (c) bilateral hyperplasia with only slight increase in size of the glands.

Manifestations of osteoporosis involving the entire skeleton and soft tissue changes of the major organs are not specific for Cushing's disease, but in the light of clinical findings may suggest the correct diagnosis.—*A. W. Sommer, M.D.*

Neck and Chest

Höffken, W. Das Aspergillom der Lunge. (Aspergilloma of the lung.) *Fortschr. a. d. Geb. d. Röntgenstrahlen u. d. Nuklearmedizin*, April, 1956, *84*, 397–407. (Address: Bürgerhospital, Neumarkt, Köln, Germany.)

Aspergilloma of the lung presents a typical roentgen appearance: a homogenous round shadow within a thin walled cavity, chestnut to egg size, usually in an upper lobe, more often on the right side and always solitary. Bronchography is usually unsuccessful, unless the segmental bronchus is entered by a catheter and aimed bronchography performed. The cyst wall can be blown up by air injection and the mass surrounded by contrast material (water-soluble only) showing that it is not attached to the cyst wall.

The differentiation from tubercular cavity is usually easy on the basis of the clinical findings, as well as the fact that there is a wide rim of infiltration around the cavity, a ragged wall around a smaller cavity and changes in the surrounding lung. Gangrene and lung abscess have a specific clinical course and change their appearance within a few days.

Aspergilloma causes hemoptysis over many years resulting in anemia and frequent episodes of simulating lung infections. The chronic cough produces purulent sputum which does not have a foul odor. The fungus usually can not be demonstrated in the sputum.

The treatment is surgical.

After a detailed discussion of the pathologic anatomy, the conclusion is reached that the aspergilloma grows in a pre-existing cavity due to secondary infection by fungus, as differentiated from aspergillosis of the lung which represents a primary agressive type of infection.—*Frederick M. Reis, M.D.*

Good, C. Allen, and McDonald, John R. Roentgenologic evidence of calcification in a peripheral bronchogenic carcinoma. *Proc. Staff Meet., Mayo Clin.*, May 30, 1956, *31*, 317–321. (From: Section of Diagnostic Roentgenology, and Section of Surgical Pathology, Mayo Clinic, Rochester, Minn.)

Calcification in a solitary intrapulmonary lesion is usually considered to be benign.

A case is reported in which an area of calcification was demonstrated in a mass proven to be bronchogenic carcinoma.

Review of chest roentgenograms made on the patient four years previously revealed that the calcium was present before the neoplasm developed, thus emphasizing the value of obtaining previous films in order to make a correct diagnosis when calcium is present in a pulmonary lesion.

Calcification may also be the result of necrotic breakdown in the center of a tumor mass.

If the lesion is heavily calcified, or if the calcium is laid down in layers, it can usually be considered to be benign. Continued respiratory symptoms particularly with hemoptosis or evidence of growth of the lesion should warrant exploratory thoracotomy.—*Wallace M. Roy, M.D.*

Birzle, H. Beitrag zur bronchographischen Technik. (Contribution to bronchographic technique.) *Fortschr. a. d. Geb. d. Röntgenstrahlen u. d. Nuklearmedizin*, April, 1956, *84*, 407–410. (From: Röntgeninstitut der Chirurgischen Universitätsklinik, Freiburg i. Br., Germany.)

A "double" is used for aimed segmental bronchography in cases of bronchostenosis. A curved tip catheter (Métras type) is used with a thinner and stiffer catheter (ureteral or cardiac type) passed inside it, so that the tip can be straightened out and directed past the stenosis. The "inside" catheter should be 10 cm. longer than the Métras catheter.

A survey bronchogram with a conventional type catheter in a main bronchus should always be done first. A free flowing, absorbable contrast medium, such as perabrodil or urografin is used to visualize the poststenotic lung.

Two cases are illustrated, one an inflammatory

bronchostenosis, the other due to tumor with demonstration of poststenotic bronchiectasis and shrinkage of lung.—*Frederick M. Reis, M.D.*

Lissner, J. Die Elektrokymographie bei pathologischen Verschattungen im Mediastinum und in Hilusnähe. (Electrokymography in pathologic densities of the mediastinum and in the proximity of the hilus.) *Fortschr. a. d. Geb. d. Röntgenstrahlen u. d. Nuklearmedizin*, May, 1956, *84*, 526–536. (From: Röntgenabteilung der Medizinischen Univ.-Kliniken, Frankfurt am Main, Germany.)

The diagnosis of mediastinal and hilar densities by roentgen examination, not too seldom, meets difficulties even when using transverse laminagraphy (Gebauer and Schanen) and kymography (Stumpf).

As an additional tool in roentgenographic diagnosis, the electrokymograph has been developed. Its advantages are described in a few recent publications. In some respects, electrokymography is superior to normal kymography. The electrokymographic tracing demonstrates movements even of a very small amplitude. Any point of a moving marginal density can be examined with the electrokymograph. Previous publications show the characteristics and differences of electrokymographic curves for transmitted pulsations.

In this paper, the possibilities of electrokymography for the demonstration and analysis of marginal movements of pathologic mediastinal and hilar processes are critically evaluated.

Cases of aortic aneurysm, coronary aneurysm, and ventricular aneurysm are described and discussed on the basis of conventional roentgenograms, transverse laminagrams, and electrokymograms, which are shown in illustrations. With these are compared cases of a thymoma, a leukosarcoma, a metastasis from a primary kidney tumor and a bronchogenic carcinoma.

The characteristics of the electrokymographic tracings of the first group are differentiated from those of the second group, and a classification of the different types is given.—*Hans Lewin, M.D.*

Petersen, Olaf. Rib notching following the Blalock-Taussig operation. *Acta radiol.*, April, 1956, *45*, 308–312. (From: Roentgen Department, University Hospital, Copenhagen, Denmark.)

The author reviews the literature, listing the causes of rib notching, with coarctation of the aorta as the most prevalent cause. Rib notching may coexist with hypertension and arteriosclerosis, aortic and mitral valvular disease, cavernous hemangioma of the thoracic wall and arteriovenous aneurysm of the intercostal vessels, neurofibromatosis, tuberosclerosis and dilatation of the intercostal veins.

Unilateral rib notching in coarctation of the aorta may be observed where stenosis is close to the origin of the left subclavian artery, also in congenital heart disease of the Steno-Fallot type, and may develop following the Blalock-Taussig operation for the latter condition. Notching appears within six months to about five years after operation and has been considered adequate evidence of a nonfunctioning anastomosis.

The author reviewed 100 cases operated on at the University Hospital. Chest roentgenograms made prior to operation showed no evidence of rib notching. Unilateral notching developed in 17 cases within thirteen to fifty-eight months, as evidenced by follow up chest roentgenograms. In 14 of the 17 cases the function of the anastomosis between the subclavian and the pulmonary arteries was satisfactory while the shunt appeared to be closed in 3 cases, as determined by clinical and angiocardiographic studies. Notching affected more than one rib, usually the third and fourth and in some cases up to the seventh. The first rib is not involved.

The author does not consider that the finding of rib notching justifies any conclusion regarding the status and function of the shunt.

Reproductions of a series of 4 roentgenograms accompany this excellent article.—*William H. Shehadi, M.D.*

Abdomen

Knoefel, P. K., Davis, L. A., and Pilla, L. A. Agglomeration of barium sulfate and roentgen visualization of the gastric mucosa. *Radiology*, July, 1956, *67*, 87–91. (Address: P. K. Knoefel, School of Medicine, University of Lousiville, Louisville 2, Ky.)

The agglomeration of barium sulfate by gastric contents impairs mucosal visualization. This is thought to be due to adsorption of mucoprotein from the gastric juice by the particles of barium sulfate. However, the volume of gastric juice was found to play an even more important part in mucosal visualization than either the agglomerating action, or actual "mucin" content of the gastric juice.

The effectiveness of numerous dispersing agents was tested, and in general, those which prevent agglomeration of barium sulfate by gastric juice also improve visualization of gastric mucosa, and vice-versa. This supports the belief that agglomeration plays a part in poor visualization. Previous studies to determine the effect of particle size were confirmed. It was again found that "micro" barium sulfate is inferior for visualization of the gastric mucosa. The authors' experimental methods and data are included, along with several graphs and tables.—*Charles L. Stevenson, M.D.*

Palmer, Eddy D. Achalasia: Anatomy of the cardia as it relates to the regional pathophysiology. *Radiology*, July, 1956, *67*, 79–83.

(Address: Message Center, Walter Reed Army Hospital, Washington, D. C.)

The author reports the results of studies to determine where the esophagogastric mucosal junction lies in achalasia in relationship to the abnormal organ configurations as they are visualized roentgenologically. Six adult males with clinical, roentgenologic, and esophagoscopic diagnosis of achalasia were studied. One of the patients had a fixed direct hiatus hernia in addition to the achalasia.

Esophagoscopy was performed on these patients and a biopsy of the esophagogastric mucosal junction was obtained. A silver brain clip was attached to the biopsy site for subsequent identification. Roentgenologic studies were then done to determine the relation of the clip to organ configuration. In each instance the gastric mucosa was found to extend upward to line the narrow segment (gastro-esophageal vestibule) as far as the brink of the dilated esophagus. Respiratory motion and the weight of the barium column in the dilated portion of the esophagus were found to have considerable influence over the length of the narrow segment. Extrinsic pressure in the region of the diaphragmatic hiatus had no control over this passive pliability.

Achalasia is a generalized disorder of the motility of the entire esophagus. It is apparently due to intimate parasympathetic denervation. In the cardia the disease is characterized by inability of the circular muscle to relax beyond its normal resting tone. This is probably partly due to the fact that it receives no activating impulse from the diseased body of the esophagus. The muscle is not in spasm and offers little resistance to dilatation.

The author feels that cardiospasm and achalasia should be considered separate entities. Cardiospasm implies persistent spasm of the circular muscle of the cardia, with esophageal dilatation which is entirely secondary to the obstruction. Achalasia is a generalized disorder of the motility of the entire esophagus, is apparently due to intimate parasympathetic denervation, and is said to show no response to spinal anesthesia. Mecholyl in achalasia causes relaxation of the vestibule but contraction of the esophygeal body.—*A. W. Sommer, M.D.*

PFEIFFER, J. Pharmakoradiographie des Magens. (Pharmacoradiography of the stomach.) *Fortschr. a. d. Geb. d. Röntgenstrahlen u. d. Nulkearmedizin*, April, 1956, *84*, 421–428. (Address: Poetenweg 5, Leipzig-N 22, Germany.)

Morphine increases the tonus and peristalsis of the stomach and speeds up emptying by overcoming pyloric and antral spasm. It proved useful in clarifying an apparent stiffness of part of the gastric wall and thus in helping differentiate between pyloric carcinoma and duodenal ulcer causing pylorospasm, as well as between annular carcinoma and stenosing antral gastritis.

Injection of 10 mg. morphine hydrochloride is followed by administration of 200 cc. barium suspension. The patient assumes the prone position immediately. The morphine effect is obtained after about eight minutes and begins to subside after fifteen to twenty minutes. The patient should remain in the horizontal position because the morphine effect is less pronounced in the upright position.

This method should only be used to supplement a "routine" type examination which is not entirely satisfactory.

Five cases are described and illustrated.—*Frederick M. Reis, M.D.*

DAVIS, JAMES G., and ADAMS, DAVID B. The roentgen findings in gastric leiomyomas and leiomyosarcomas. *Radiology*, July, 1956, *67*, 67–73. (Address: J. G. Davis, St. Luke Hospital, 2632 E. Washington St., Pasadena 8, Calif.)

A brief discussion of the incidence, clinical features, and pathology of leiomyomas and leiomyosarcomas is presented. Nine proved cases, including the case reports, consisting of 2 leiomyomas and 7 leiomyosarcomas, form the basis of this study.

These 9 cases fall into 4 distinct radiological categories: (1) intramural-extramucosal tumors with or without mucosal ulceration; (2) exogastric tumors; (3) polyp-like tumors; and (4) fungoid intraluminal tumors.

In the intramural-extramucosal type of lesion, a sharply outlined mass was found effacing the overlying mucosa and with an abrupt transition to normal mucosa at the tumor margin. All of the 4 lesions of this category showed 1 or more mucosal ulcerations. The stomach was mobile and peristalsis was not disturbed except at the tumor site. It was not possible to differentiate between leiomyoma or leiomyosarcoma. Other intramural tumors present similar appearances, and both benign and malignant tumors of all the histologic types in the stomach must be considered in the differential diagnosis.

The 2 exogastric tumors in this series arose in the stomach wall and their growth was principally outside the stomach proper. The roentgen findings consisted of a soft tissue mass which displaced the stomach and stretched the mucosa as with other extrinsic masses. No mucosal ulcerations were seen in these cases. At fluoroscopy the stomach and mass could not be separated. The differential diagnosis must include other masses arising from the liver, pancreas, kidney, adrenal, omentum, mesentery, and aorta.

Two polyp-like tumors were in this series and they had the roentgenographic appearance of mucosal polyps. One of these partially prolapsed into the duodenal bulb. The differential diagnosis should include adenomatous polyps, aberrant pancreatic nodules, and hamartomas.

In one case the roentgenographic appearance was

that of a fungoid carcinoma, with irregular filling defects in the lumen of the stomach.

This study shows that gastric leiomyomas and leiomyosarcomas have no single characteristic roentgenographic feature. The authors conclude that the only reliable method of determining precisely the type of tumor with which one is dealing, is by prompt surgical removal and histologic examination.—*Donald N. Dysart, M.D.*

Rogers, James V., Jr., and Adams, Elizabeth K. Gastric lipoma; case report. *Radiology*, July, 1956, *67*, 84–86. (Address: J. V. Rogers, Jr., Emory University Hospital, Emory University, Ga.)

A case of gastric lipoma in which the roentgenographic findings suggested the proper diagnosis is presented. A large mass which was definitely less dense than the adjacent tissues, indicating that it was made up of fatty tissue, was demonstrated in the antrum of the stomach. Two large ulcerations were present within the mass.

Submucosal gastric tumors in which fatty tissues can be demonstrated roentgenographically probably represent gastric lipomas or, infrequently, dermoid cysts. The antrum is the usual site of gastric lipomas and approximately a third of all lipomas of the stomach have overlying ulcerations.—*Harold C. Hamilton, M.D.*

Teplick, J. George. Duodenal loop changes in posterior penetration of duodenal ulcer. *Ann. Int. Med.*, May, 1956, *44*, 958–974. (From: Department of Radiology, Kensington Hospital, Philadelphia, Pa.)

The author adds several cases to the literature of changes in the duodenal loop secondary to posterior penetrating duodenal ulcer. These changes can be caused by inflammatory lesions or adhesions around the bulb and descending duodenum as well as by a secondary pancreatitis.

In 9 of the author's 10 patients the ulcer history was of more than five years' duration. Backache was a prominent symptom in four.

On roentgenologic examination, the actual position of the ulcer was demonstrated in only one case. Loop changes consisted of effacement of the normal mucosal pattern on the inner border, and coarsening of the mucosal folds.—*Lawrence A. Davis, M.D.*

Cimmino, Christian V. Experiences with the upright fluoroscopic spot-film examination of the gallbladder. *Radiology*, July, 1956, *67*, 74–78. (Address: Mary Washington Hospital, Fredericksburg, Va.)

Upright fluoroscopic spot-film examination of the gallbladder as a part of the usual contrast study is of definite value in the demonstration of minute filling defects. The author feels that this method has definite advantages over the prone and lateral decubitus views, because it allows the roentgenologist to choose the exact positioning needed to obtain the most unobstructed view of the opacified gallbladder. The most opportune degree of compression can also be selected with this technique.

A spot-film device with a fine focus (1.0 square mm., or less) rotating anode tube is needed. A high fat lunch is given the day before the examination, and a preliminary abdominal scout film is made before the six tablets of telepaque are given. The next morning the thorax and abdomen are scanned fluoroscopically, and the gallbladder shadow is located. Then spot-films are made with varying degrees of rotation and compression. The most cephalic reaches of the gallbladder should be included. A 1.0 per cent tannic acid enema is given to cleanse the hepatic flexure, if needed, to obtain an unobstructed view of the gallbladder. With the author's equipment, the technical factors for the "average" patient are: 70 kv., 0.2 second, and 200 ma., with no grid.

If satisfactory gallbladder visualization is not obtained, six more telepaque tablets are given, and this procedure repeated the next day. If then no gallbladder shadow is seen fluoroscopically, films in the prone and oblique views are made, with an overhead tube, to see if a shadow of diminished density or stones can be demonstrated. No subsequent fatty meal is given because of the author's high efficiency of demonstrating calculi without it. If visualization of the biliary tree is desired, other techniques are employed later. A gastrointestinal examination is done immediately afterwards, because of the inaccuracy in clinical differentiation between gallbladder disease and gastric ulcer.

A single "negative" gallbladder study does not rule out gallbladder disease, because of the erratic demonstrability of minute filling defects. Therefore, in patients with a typical clinical picture of gallbladder colic, repeated examinations are felt justified.

Five case reports and several film reproductions are included, which demonstrate the success of the author's technique.—*Charles L. Stevenson, M.D.*

Aldridge, N. H. Combined intravenous cholecystography and pyelography. *Brit. J. Radiol.*, March, 1956, *29*, 127–132. (From: Diagnostic X-ray Department, The General Infirmary, Leeds, England.)

Intravenous pyelography has been in use for over twenty-five years. The diagnostic value has recently been improved by introduction of a new medium, sodium acetrizoate, which contains a third atom of iodine held in the molecule. Cholecystography has been in use longer than excretion urography and media in current use are given orally. Biligrafin, an intravenous medium, was introduced in 1953 and immediately became popular because of its ability to demonstrate not only the gallbladder, but the main

ducts. Visualization of the ducts after cholecystectomy became possible with use of this new product.

Since excretion urography and visualization of the biliary tracts both require preparation and intravenous administration, the author has explored the feasibility of combining the two examinations. After determining that mixtures of the media were not toxic, a series of 50 cases was examined by the combined technique. Diodone-biligrafin mixture was favored over sodium acetrizoate-biligrafin mixture, because of the excessive concentration in the pyelograms and its persistence when sodium acetrizoate was employed. The use of a preliminary fat meal and of pethidine intravenously to contract the sphincter of Oddi allows the examiner to control the appearance of the biliary ducts until after the pyelography has been completed.

Numerous illustrations demonstrate the combined technique.

The method is not recommended for routine work in a large department.—*Richard E. Kinzer, M.D.*

Mitchell, David J. Basic combined cholecystangiography. *Brit. J. Radiol.*, March, 1956, *29*, 133–138. (From: Royal Albert Edward Infirmary, Wigan, Lancs., England.)

Visualization of the entire biliary tract was seldom accomplished until biligrafin became available. It was first used for definition of hepatic and common ducts in patients who had had cholecystectomy and in patients who had had failure of definition of the gallbladder by the usual oral methods.

In order to demonstrate hepatic, cystic, and common bile ducts simultaneously with filling of the gallbladder, the author advocates a combination of oral cholecystography supplemented with intravenous biligrafin to demonstrate the ducts.

A series of 100 examinations is reported and many good illustrations are included. Advantages and disadvantages are listed. Completeness of biliary tract demonstration in a short time seems to be one of the chief advantages.—*Richard E. Kinzer, M.D.*

H:son Holmdahl, Kaj. Cholecystography during lactation. *Acta radiol.*, April, 1956, *45*, 305–307. (From: Roentgen Department, University Hospital, Upsala, Sweden.)

Opinions regarding the reliability of oral cholecystography during lactation had been expressed by Olsson in 1943 and Polgár in 1944. They reported that iodine may be excreted in the milk with an adverse influence on the mother and child. In their investigations they used the contrast media for cholecystography available at that time, i.e. prior to the era of telepaque.

The author investigated 21 lactating mothers, using telepaque in 11 cases and bilijodin in 10 cases. The milk was analysed for its iodine content by incineration, oxidation and titration with sodium thiosulphate.

The author concludes that when telepapue, and preparations of the telepaque type, are used, oral cholecystography during lactation is reliable. No adverse effects were noted in the infant and the iodine excretion in the milk does not alter the accuracy of the cholecystographic examination.

Two diagrams and one table accompany this article.—*William H. Shehadi, M.D.*

Lee, C. Marshall, Jr., Newstedt, J. Roger, and Siddall, H. Stewart. Large abdominal tumors of childhood (other than Wilms' tumor or neuroblastoma). *Ann. Surg.*, June, 1956, *143*, 803–815. (From: Department of Surgery of the University of Cincinnati, College of Medicine, and the Surgical Services of the Cincinnati Children's Hospital and the Cincinnati General Hospital, Cincinnati, Ohio.)

Sixty-seven consecutive cases of palpable abdominal tumors in children fourteen years of age or younger are reported. Twenty-three were renal embryomas, 16 neuroblastomas, and 28 fell into the group of lesions which, while each is uncommon, "comprise the largest proportion of the whole."

Seven hepatomas, 2 adenocarcinomas, 6 ovarian tumors, and 10 assorted tumors of the bowel, mesentery, peritoneum and retroperitoneum are included in the heterogenous group of 28.

The attempt to rule out neuroblastoma or Wilms' tumor in favor of a more rare abdominal mass is difficult. Virtually all neuroblastomas and most renal embryomas occur under the age of five years. An uncomfortable or actually painful mass is more likely to be other than a Wilms' tumor or sympatheticoblastoma.

Duration of symptoms was of little diagnostic value in this series. Anemia, however, was found in a significantly higher percentage of the common tumors than in the miscellaneous group.

Roentgenologic study was of considerable aid, especially in detecting renal and suprarenal tumors and in demonstrating well defined calcifications in teratomas.

The presence of a large abdominal mass in a child does not justify the assumption of the presence of a renal embryoma or neuroblastoma and pre-biopsy irradiation or radiation therapy alone is deplored. There is no acceptable substitute for direct inspection and biopsy before appropriate definitive treatment.—*Dale W. Undem, M.D.*

Gynecology and Obstetrics

Holm, Olov Fr. Occurrence of free gas in the fetus in cases of intra-uterine death. *Acta radiol.*, April, 1956, *45*, 257–265. (From: Roentgen Department, Länslasarettet, Falköping, Sweden.)

That the fetus contains free gas is sometimes found

in cases of intra-uterine fetal death. The gas generally lies in the vascular system of the fetus, but occasionally is also situated in other parts of the body.

Small amounts of gas in the fetus may frequently be difficult to distinguish from gas in the mother's intestines. Often special projections, varied from case to case, are necessary for success.

Among 13 cases in the author's material, examined before and after parturition, there were 9 fetuses containing gas. In 7 of these cases, the diagnosis could be made before partus.

The other roentgenologic sign of intra-uterine fetal death consists in the demonstration of maceration. Roentgenologic signs of maceration may be detected, at the earliest, four to seven days prior to partus but as a rule not earlier than two to three weeks after fetal death.

In 16 known cases, there were no other roentgenologic signs of intra-uterine fetal death.

It was observed that a certain relation between the abundance of gas and the degree of maceration exists.

In all instances, the gas was situated in the heart, aorta, and some of the major arteries. In several cases, there was gas also in the inferior vena cava and vessels of the navel. In most cases, the gas occurred abundantly also in a number of minor vessels which could not be definitely determined, the particular regions involved then being the liver and spleen.

Nothing is known with certainty regarding the mechanism in play when the gas is formed. The author makes the following hypothesis regarding the formation of gas. When hemoglobin undergoes decomposition, the chemically bound oxygen is liberated. If this takes place suddenly it is possible that so much oxygen may be set free that it cannot enter into physical combination with the available blood fluid stagnant. This will lead to free gas being accumulated in the vessels.

At first the author supposed that the gas consisted of oxygen, since most frequently this gas is situated mainly in the left side of the heart and in the major arteries where the blood is oxidized.

The specific gas conditions prevailing in the fetus also seem to lend support to this reasoning. The fetus is living fairly normally at a gas pressure so low that at the same pressure a grown-up person would die from lack of oxygen within a few minutes. As a compensatory factor, the number of blood corpuscles in a fetus are 20 per cent higher than in an adult. Furthermore, the hemoglobin of the fetus is of another composition than in the adult, its capacity for combining chemically with oxygen being much greater.

It is also possible, however, that the chemically bound carbon dioxide may behave in a corresponding manner. Carbon dioxide combines with hemoglobin in the same manner as oxygen but is also chemically bound to the plasma.

In the cases reported by Crick and Sims, it was found by analysis that the gas sucked from the fetus consisted almost entirely of pure nitrogen. They observed that the mechanism of gas formation could not be determined from their investigations.—*Stephen N. Tager, M.D.*

Wiltse, Leon L., and Frantz, Charles H. (Long Beach, Calif., and Grand Rapids, Mich.) Non-suppurative osteitis pubis in the female, *J. Bone & Joint Surg.*, June, 1956, *38-A*, 500–516.

The authors report the occurrence in 13 women of non-suppurative osteitis pubis which they believe is similar to the disease in men.

The typical female patient is young, and experiences pain about the symphysis within a few months after some event producing trauma to this region. The majority of these patients were either in the third trimester of pregnancy or in the postpartum period; in 2 the disease followed injury, and in 1 it followed pelvic surgery. There was no suppuration or abscess formation, and within a year nearly all patients were well.

Roentgenographically there was instability at the symphysis with spotty demineralization. Later this was followed by narrowing and sclerosis.

A biopsy in one case showed no evidence of infection, either acute or chronic; the changes were all degenerative.

The authors believe that osteitis pubis in women is a localized reflex neurovascular dystrophy which is brought about by a combination of trauma and predisposing changes in the symphysis conditioned by certain hormones. Treatment should be symptomatic since the disease is self limiting.—*Lawrence A. Davis, M.D.*

Genitourinary System

Lentino, Walter, Zeitel, Bertram E., Jacobson, Harold G., and Poppel, Maxwell H. Intravenously given urographic mediums; comparative study of eight hundred cases. *J.A.M.A.*, June, 1956, *161*, 606–609. (H. G. Jacobson, 210th Street and Bainbridge Avenue, New York, N. Y.)

A carefully controlled study of commonly used urographic media is reported from clinical experience at Montefiore and Bellevue Hospitals in New York. Media employed in each of 4 groups of 200 patients were a 50 per cent solution of sodium iodomethamate (neo-iopax), 50 per cent solution of sodium acetrizoate (urokon), 50 per cent solution of diatrizoate sodium (hypaque) and 76 per cent solution of renografin (mixture of sodium and methylglucamine salts of diatrizoate). Diagnostic urograms were obtained in a significant percentage in all groups, but the highest percentage of excellent studies was obtained with the hypaque and renografin. The 50 per cent solution of urokon produced the greatest

number of side-reactions, whereas the renografin produced the least. However, renografin proved somewhat more difficult to handle because of its relatively higher viscosity requiring preliminary warming to body temperature and use of large bore needles in filling the syringe. A definite relation was observed between a history of allergy and drug reactions, in that the allergic group experienced more reactions than would be expected from the general population. No accurate prediction of adverse effects could be obtained through preliminary ocular and intradermal tests. The authors suggest that an intravenous test with a small dose of the medium used may be helpful in the individual with a positive history of allergy in order to avoid a large injection of allergin.—*James A. Martin, M.D.*

Green, B., and Sowerbutts, J. G. A comparative study of the value of sodium acetrizoate (diaginol) 50 per cent and sodium diatrizoate (hypaque) 45 per cent in intravenous urography. *Brit. J. Radiol.*, March, 1956, *29*, 161–165. (From: Diagnostic Radiology Department, St. Bartholomew's Hospital, London, E.C.1 and Diagnostic Radiology Department, The London Hospital, London, E.1, England.)

Many reports have appeared on the use of sodium acetrizoate 35 per cent and 70 per cent and the authors take this opportunity to describe their experience in the use of the 50 per cent solution. Two hundred and fifty patients were examined at St. Bartholomew's Hospital with 50 per cent sodium acetrizoate (diaginol, urokon). These were compared with 250 patients examined with hypaque at the same hospital and with 250 cases examined with hypaque at The London Hospital.

Hypaque was found to be superior for general use because of a reduced number of both local and general reactions. Both media gave satisfactory results. —*Richard E. Kinzer, M.D.*

Liming, Robert W., and Youngs, Franklin J. Metastatic vertebral osteomyelitis following prostatic surgery. *Radiology*, July, 1956, *67*, 92–94. (Address: R. W. Liming, Salem Hospital, Salem, Mass.)

The authors report 2 cases of metastatic vertebral osteomyelitis following prostatic surgery, adding to the 8 cases previously reported in the literature. Other similar vertebral involvement has been described associated with or in the presence of urinary tract infection. The spread from the genitourinary tract is by means of the vertebral system of veins as described by Batson.

In one case acute pain developed in the lower back about two weeks following transurethral prostatic resection and roentgenograms revealed destruction of the opposing halves of the bodies of L-2 and L-3. In the second case the patient had an abscess of the prostate. The prostate was resected transurethrally after the acute prostatitis had subsided. A backache in the dorsal region appeared about one week following surgery and about two and one half weeks later signs of cord compression at the D-4 level became evident. Roentgenograms revealed a destructive process of the opposing portions of D-4 and D-5, narrowing of the interspace, and a paravertebral mass which was thought to represent an abscess.—*Donald N. Dysart, M.D.*

Close, Myron B., Peterson, Carrell A., and Johnson, Richard P. Bilateral embryoma of the kidney: patient alive and well three years after treatment. *Radiology*, July, 1956, *67*, 99–101. (From: Children's Hospital of the East Bay, Oakland 9, Calif.)

A case of histologically proved bilateral Wilms' tumor in an 8-month old white boy who is alive and well three years after right nephrectomy, biopsy of the left kidney, and bilateral roentgen therapy is reported. The patient received a total of 1,600 r to the right renal fossa after nephrectomy and a total tumor dose of 2,300 r to the left kidney. The preoperative irradiation of the left kidney and postoperative therapy to both kidney areas were completed in a seven-week period which included a one-week interval at the time of operation on the left kidney when no therapy was given.

Since the great majority of those embryomas of the kidney which recur do so within the first nine months, Gross considers an arrest of eighteen months to be a cure. To the best of the authors' knowledge, this case represents the first histologically proved bilateral Wilms' tumor with survival for more than a few months. Since this report was submitted the child has been observed again and appeared to be in excellent health four years after the completion of treatment.—*Harold C. Hamilton, M.D.*

Skeletal System

Bakwin, Harry. Multiple skeletal lesions in young children due to trauma. *J. Pediat.*, July, 1956, *49*, 7–15. (From: Department of Pediatrics, New York University College of Medicine, and Children's Medical Service, Bellevue Hospital, New York, N. Y.)

Despite their frequency, traumatic bone lesions in early childhood are often missed. The author describes several cases where no accurace history could be obtained. Usually this lack of history is due to the unwillingness of the parents or others in charge of the child's care, to admit any element of negligence. Symptoms when present are generally mild and easily overlooked. The most frequent clinical findings are pain, irritability, tenderness, and restricted motion. Roentgen changes are unlike the changes characteristic of trauma during later child-

hood and adult life, and with the exception of frank fracture may not appear for several days after injury.

Roentgenographic bone lesions discussed include subperiosteal ossification, metaphyseal fractures, avulsions, gross fractures, impact fractures, and epiphyseal displacements. Cortical thickening may appear as a result of periosteal separation and subsequent ossification. It may be seven to ten days later that a new cortex of bone is visible. This is widest at the end of the bone and may extend beyond the epiphyseal line where provisional zone of calcification has been torn away. This subperiosteal ossification is often confused with scurvy; however, the ground glass osteoporosis, cortical thinning and epiphyseal rings of scurvy are absent. Also, scurvy almost never occurs in the first five months, whereas skeletal injury is common. Fractures and cortical thickening are seen in syphilis but usually the findings are symmetrical and one has a positive serology. Metaphyseal fractures are also frequently seen, and are usually multiple. Impacted fractures may show abnormal angulations of the bone, and later exhibit formation of new cortical bone. Traumatic dislocations of epiphyseal centers are rare. If the center has been calcified it will show displacement in relation to the shaft.

These traumatic lesions heal rapidly and the result is good unless growing cartilage is injured.—*Kriss M. Kerr. M.D.*

Willich, E. Subepiphysäre Aufhellungslinien beim Säugling unter besonderer Berücksichtigung der Osteomyelitis. (Subepiphyseal linear translucencies of early infancy with special consideration of the osteomyelitis.) *Fortschr. a. d. Geb. d. Röntgenstrahlen u. d. Nuklearmedizin*, May, 1956, *84*, 587–597. (Address: Kinderklinik d. Städt. Krankenanstalten, Friedrich-Karl-Str. 10, Bremen, Germany.)

A short review is given of the literature and the pathologic conditions in which roentgenograms of the long bones of young infants show linear translucencies in the subepiphyseal areas are discussed. Sixteen cases of osteomyelitis are described. Eleven of these sixteen cases showed linear translucencies during the first two weeks, which period has been named the "radiologic negative phase." Difficulties in the differentiation from early osteochronditis luetica may arise. The close relationship to congenital syphilis is discussed on the basis of the properties of the reaction of the infantile bone. Serological tests, if negative, rule out congenital syphilis. According to the author, the linear translucencies represent a nonspecific reaction of the growing bone to diseases of different etiology, including congenital syphilis. They are indications of a trophic disturbance of the enchondral ossification. If combined with local symptoms, purulent foci and leukocytosis, osteomyelitis has to be considered in differential diagnosis.

Numerous illustrations show the linear subepiphyseal translucencies in the early phase of osteomyelitis, which later are replaced by linear densities or by the typical osteomyelitic changes.—*Hans Lewin, M.D.*

Schultz, E. H., Jr., Levy, R. W., and Russo, P. E. Agenesis of the odontoid process. *Radiology*, July, 1956, *67*, 102–105. (Address: E. H. Schultz, School of Medicine, University of Oklahoma, Oklahoma City 5, Okla.)

Failure of ossification of the odontoid process of the second cervical vertebra is a rare developmental anomaly. It usually causes no symptoms but may be accompanied by persistent neurologic findings.

The authors report a case of congenital absence of the odontoid process with severe neurologic symptoms. The patient, a twenty-nine year old male had a marked quadriparesis, with pronounced atrophy of the small muscles of the hands and the peroneal group bilaterally. The clinical impression was amyotrophic lateral sclerosis. The diagnosis was established by roentgenographic studies which included laminagraphy and myelography. Surgical exploration revealed a severe adhesive arachnoiditis with narrowing of the spinal cord at this level. Partial regression of symptoms followed decompression laminectomy.—*A. W. Sommer, M.D.*

Fenton, Richard L. (New York, N. Y.) The naviculo-capitate fracture syndrome. *J. Bone & Joint Surg.*, June, 1956, *38-A*, 681–684.

The nature and intensity of the force which fractures the capitate is apparently such that it rotates the proximal fragment 180 degrees. In both of the author's cases this rotation occurred and the result was that the joint cartilage, which covers a large portion of the proximal fragment, was found in contact with the fractured surface of the distal fragment. There was an associated navicular fracture.

Because the fragment of the capitate is avascular and because it is rotated 180 degrees, its excision is necessary. Prolonged immobilization is required in case of the navicular fracture.—*James J. McCort, M.D.*

Avin, Joseph. The male Turner syndrome. *A.M.A. Am. J. Dis. Child.*, June, 1956, *91*, 630–635. (Address: 835 Ocean Ave., Brooklyn 26, N. Y.)

Turner in an article published in 1938 (A syndrome of infantilism, congenital webbed neck and cubitus valgus. *Endocrinology*, 1938, *23*, 566) described this entity in 7 short girls, aged fifteen to twenty-three years. Since then many similar cases have been reported and the syndrome has been further elaborated.

The essential features are as follows: (1) gonadal

agenesis, with resultant primary amenorrhea, poorly developed secondary sex characteristics, increased gonadotropin and diminished 17-ketosteroid excretion; (2) skeletal defects, including short (not dwarfed) stature, a constant finding and a group of occasional anomalies such as webbed neck, short neck, cubitus valgus, shield-shaped chest, wide arm span, fused cervical vertebrae and shortened phalanges; and (3) associated non-skeletal anomalies including mental retardation, ocular and renal defects and vascular anomalies.

An eleven year old male patient is presented. Therapy did not alter the growth curve.—*James J. McCort, M.D.*

Finby, Nathaniel, Jacobson, Harold G., and Poppel, Maxwell H. Idiopathic coxa vara in childhood. *Radiology*, July, 1956, *67*, 10–16. (Address: H. G. Jacobson, 210th St. and Bainbridge Ave., New York 67, N. Y.)

Idiopathic coxa vara in children may be seen either as a congenital malformation or a developmental change in the proximal femur. Although discussions of this condition have frequently appeared in the orthopedic and surgical journals, few are to be found in the radiologic literature. The authors considered, therefore, that a report on this subject in a radiologic journal would be of interest. Seven cases of congenital and 16 cases of developmental coxa vara are presented.

It is pointed out that there are 2 main points of difference between the congenital and developmental groups. In the congenital cases, the age of onset is earlier and there are associated anomalies. The developmental form does not usually occur until after the fourth year and other anomalies are not seen. It was also noted that while only 1 in 7 cases was bilateral in the congenital type, 6 out of 16 of the developmental type were bilateral. Also there was a striking preponderance of female patients in the latter group.

Clinical data on the 23 cases studied are presented in a tabular form. It is of particular interest to note that pain was not a prominent symptom in these cases until walking and weight bearing produced secondary changes. In both groups, limp was associated with noticeable shortening on the affected side, and in bilateral cases, a characteristic waddle and pronounced lumbar lordosis were observed. Elevation of the trochanters, limitation of extension and rotation at the hip, and a positive Trendelenburg sign were the chief findings on physical examination.

Roentgen features were similar in both groups of idiopathic coxa vara. The chief difference lay in the presence of other anomalies in the congenital type These included acetabular dysplasia, femoral shortening, and multiple associated abnormalities. Roentgenographically, both types had a diminution of the angle of inclination of the femoral neck and shaft below a normal 120 degrees. Associated with this change was a relative elevation of the greater trochanter, which often appeared large and beaked. In almost all the patients, there was irregularity and fragmentation of the proximal metaphysis which was often productive of a loose triangular fragment at the margin of the metaphysis and short hypoplastic femoral neck.

The pathology and pathogenesis of idiopathic coxa vara are not clear. A tenable hypothesis suggests deficient osteogenesis in the femoral neck region, with a development of pseudoarthrosis.

The best treatment of idiopathic coxa vara at present appears to be a subtrochanteric osteotomy at an early age, to promote solidification of the femoral neck with an improved alignment in weight bearing.—*A. Ralph Watson, M.D.*

Balzarini, Emilio, and Pompili, Giuseppe. Tecnica e anatomia radiografica normale dello sterno. (Technique and radiographic anatomy of the normal sternum.) *Radiol. med.*, July, 1956, *42*, 625–637. (From: Istituto di Radiologia della Università, Milano, Italy.)

This paper consists of two parts. In the first, the authors deal with the embryologic development of the sternum, its normal roentgenographic anatomy, and the various techniques of examination.

The pathologic alterations of the sternum as demonstrated roentgenologically will be analysed in a second part later.

Among the techniques reviewed, particular attention is paid to the standard left anterior oblique view, to laminagraphy, and to plesioroentgenography or "contact" roentgenography.—*A. Govoni M.D.*

Duncan, J. G. Radiological manifestations of hyperparathyroidism. *Proc. Roy. Soc. Med.*, May, 1956, *49*, 283–286. (From: Royal Infirmary, Edinburgh, Scotland.)

The importance of the radiologist in the diagnosis of hyperparathyroidism is stressed. Fourteen cases of the disease are reviewed in which 78 per cent showed skeletal changes and 50 per cent had renal calculi. Most all patients in which there were skeletal changes exhibited the usual roentgenographic findings. Generalized osteoporosis was present in the spine and granular punctate osteoporosis was noted in examinations of the skull. Subperiosteal erosions and cystic changes were common in the phalanges and extremities.

An unusual feature in one patient was absorption of the terminal phalanges of the hands, leaving osteoporotic tufts and resulting in over-all shortening. There was also an associated bullous expansion of the pulp of the fingers. This clubbing of the fingers is thought to be due to loss of skeletal support.—*Wallace M. Roy, M.D.*

Bolen, John G. Diabetic Charcot joints. *Radiology*, July, 1956, *67*, 95–98. (Address: 1216 Pennsylvania Ave., Fort Worth, Texas.)

A rare complication of diabetes mellitus is the production of neuropathic joint changes in the foot. Early descriptions of neuropathic or Charcot joints represented them as pathognomonic of syphilis, but similar findings have been reported in leprosy, peripheral nerve injury, syringomyelia, pyogenic soft-tissue infections following puncture wounds, and other infections secondary to trauma. Only 29 complete case reports of Charcot joints secondary to diabetic neuropathy could be found by the author in the available medical literature. Two new cases are presented in this report.

The etiology of Charcot joints in diabetes mellitus remains controversial, but theories regarding the origin of the condition include diminution of blood supply, peripheral neuritis, and extension to bone from a soft tissue infection.

Clinically, the process usually begins after several years of poorly regulated diabetes. Early signs and symptoms include relatively painless swelling of the tarsometatarsal region, with gradual eversion of the foot. The disease progresses slowly to partial or complete necrosis of the tarsal bones and obliteration of their normal joint relationships.

Pathologically, there is almost complete loss of normal bone structure, with some areas showing different stages of destruction and other areas presenting periosteal new bone formation. Degenerative changes in the synovial membranes and moderately increased vascularity of the adjacent soft tissues are present, with hypertrophy of the vessel walls. Examination of sections of the peripheral nerves reveals edematous changes only.

Treatment of the joint lesions in diabetes is generally unsatisfactory. The changes, once begun, are slowly progressive in spite of antibiotic therapy and careful diabetic management. Two cases have been reported, however, in which the degenerative process was apparently arrested after lumbar sympathectomy. Some authors have suggested immobilization of the foot and ankle to prevent weight bearing and further deformity. Because of pain, deformity, and the extreme difficulty of regulating diabetes in the presence of a chronic infection, amputation of the affected extremity was chosen as the treatment of choice in the 2 cases reported in this article.—*A. Ralph Watson, M.D.*

Blood and Lymph System

Saltz, Nathan J., Luttwak, Edmund M., Schwartz, Armin, and Goldberg, Gil M. Danger of aortography in the localization of pheochromocytoma. *Ann. Surg.*, July, 1956, *144*, 118–123. (From: Departments of Surgery, Radiology and Pathology of the Rothschild-Hadassah University Hospital and the Hebrew University-Hadassah Medical School, Jerusalem, Israel.)

The authors report a second instance of death following use of aortography in localizing a pheochromocytoma. These tumors often cannot be localized by plain films, pyelography, laminagraphy and air insufflation; in addition, they often cannot be found upon surgical exploration.

It was against this background that, following unsuccessful presacral air study, aortography was performed with the realization that its value and safety for medullary lesions were by no means established. Three injections each of 20 cc. of 70 per cent diodrast were made over a thirty minute period, and excellent visualization of the tumor was obtained. The patient, however, went into profound shock and expired twenty-four hours after aortography.

Necropsy examination revealed a retroperitoneal hemorrhage surrounding the tumor. It has been postulated that a very minor operative procedure will in these patients stimulate the adrenal to pour out large amounts of adrenalin, thereby producing a hypertensive crisis and causing extravasation from the already weakened vessels in the area about the tumor. This local area of hemorrhage provokes the hypertensive crisis by causing local pressure on the tumor which then secretes more and more adrenalin. It has also been postulated that the vascular hemotoxic effect of diodrast may have initiated the process by causing the retroperitoneal hemorrhage surrounding the tumor.

The authors state that the train of events was, beyond doubt, secondary to the aortography, thereby placing this method of localization in a questionable position.—*Henry J. Teufen, M.D.*

Enselberg, Charles D. The clinical picture of aneurysm of the abdominal aorta. *Ann. Int. Med.*, June, 1956, *44*, 1163–1181. (From: Department of Cardiology, New York Polyclinic Medical School and Hospital, and the Medical Division, Montefiore Hospital, New York, N. Y.)

This is an analysis of 37 patients with aneurysm of the abdominal aorta. The chief symptom is pain and the chief sign an abdominal mass. Renal disease is often suggested by the pain; examination shows the mass to be tender and pulsating. A curvilinear calcification in the wall of the mass will confirm the diagnosis. Rupture of the aneurysm is a frequent terminal occurrence.—*James J. McCort, M.D.*

Murphy, Thomas O., and Margulis, Alexander R. Roentgenographic manifestations of congenital peripheral arteriovenous communications. *Radiology*, July, 1956, *67*, 26–33. (Address: T. O. Murphy, University of Minnesota Hospitals, Minneapolis 14, Minn.)

There are at least 3 types of congenital arteriovenous communications: (1) the glomus body, a normal physiologic arteriovenous communication involved in body heat stabilization, under neuromuscular control; (2) the "central" arteriovenous communication, in which major vessels of either the peripheral vascular bed or the pulmonary circuit are involved, producing easily recognizable symptoms of a systemic nature; and (3) the "peripheral" or maldeveloped type of glomus unit. These usually lie deeper than the normal glomus unit, have a lumen larger than 0.1 mm. in diameter, and are under little or no neuromuscular control. This type is probably much more common than generally realized.

This report is concerned with the roentgenographic findings in 8 patients with the "peripheral" or maldeveloped glomus unit type of arteriovenous communication in the lower extremity. The details of the authors' technique of demonstrating these abnormal shunts by arteriography are given, and many excellent arteriograms are reproduced, demonstrating the findings.

The diagnostic findings have been divided into 4 groups, as follows:

(1) Primary Diagnostic Signs of Congenital Arteriovenous Communications:
  (a) Presence of venous rete.
  (b) Filling of superficial veins simultaneously with filling of large arteries.
(2) Diagnostic Signs Occurring in Advanced and Massive Involvement:
  (a) Filling of deep veins simultaneously with filling of major arteries.
  (b) Systemic effects, such as cardiac enlargement and increased pulmonary vascularity.
(3) Signs of Arteriovenous Communications That Are Significant by Their Multiplicity and Prominence:
  (a) Abnormal segmentation of small branches from the main arteries.
  (b) Frequency of vessels parallel to a deep artery, which are connected with it by a perpendicular horizontal vessel to form an "H."
  (c) Non-tapering of peripheral branches, when occlusive arterial disease is not present.
(4) Nonspecific Associated Changes with Arteriovenous Communications:
  (a) Increase in size of extremity.
  (b) Irregular soft tissue contour of the involved extremity.

In any one case, the deviation from normal is one of degree, both clinically and roentgenographically. —*Charles L. Stevenson, M.D.*

HELANDER, C. G., and LINDBOM, Å. Roentgen examination of the inferior vena cava in retroperitoneal expanding processes. *Acta radiol.*, April, 1956, *45*, 289–297. (From: Roentgendiagnostic Department, Karolinska Sjukhuset, Stockholm, Sweden.)

In 1935 dos Santos reported on visualization of the inferior vena cava by the use of a contrast medium. Many reports by others have since appeared. None the less, examination of the inferior vena cava in this manner has not received the attention it deserves.

The authors describe their own technique and report their findings in 55 cases so examined. A local anesthetic is used and a polyethelyne catheter is introduced into each common iliac vein. This procedure is employed in preference to simple injection into the veins as it assures easier handling of the patient and precludes the possibility of extravasation into the tissues.

Twenty-five cubic centimeters of a 20 per cent solution of sodium acetrizoate are injected at the rate of 7–10 cc. per second through the catheters. An exposure is made at the end of the injection and two seconds later. A manually operated cassette is used. The patient is instructed to strain heavily, holding his breath during the examination. Films are exposed in the anteroposterior supine position and with the left side elevated 45 degrees.

The vena cava, with thin walls, can be easily deformed by expanding retroperitoneal masses, and tumors of the size of a small walnut should be readily detected.

Of the 55 patients examined 39 were normal and 16 were pathological, revealing varying degrees of deformity and compression of the vena cava. The tumors encountered were: malignant lymphoma, 7; metastasis from uterine carcinoma, 3; ganglioneuroma, renal and suprarenal tumors, 1 each; sarcoma growing into the vena cava and right auricle, 1; hydronephrosis, 3.

Accurate localization of the site of the mass in malignant disease is most important. Irradiation of the area of deformity improves the patient's condition and the deformity decreases or disappears. The finding of such a deformity in patients with uterine carcinoma is most significant in determining the prognosis and outlining the treatment.

Reproductions of 9 roentgenograms and one table accompany this excellent article.—*William H. Shehadi, M.D.*

GENERAL

STANFORD, R. W., and HILLS, T. H. An advance in x-ray film processing. *Brit. J. Radiol.*, May, 1956, *29*, 286–294. (From: Physics Department of the Medical School, and Diagnostic X-ray Department, Guy's Hospital, London, S.E.1, England.)

The diagnostic value of any roentgen film is dependent on its quality. Exact repetition of the exposure and carefully controlled processing are essential if such films are to be comparable in density and contrast. A method of obtaining a sufficiently constant level of activity for an almost unlimited

period of time has been devised. The details are described in this paper.

Analyses of the developer in normal use, *i.e.* under conditions in which about 300 films representing the average in number and exposure of a general radiologic department were processed each day, revealed small changes in *p*H and in the concentrations of metol, hydroquinone, carbonate and sulphite, accompanied by a steady increase in the bromide concentration. The system adopted was based upon the principle that the developer must be treated so as to keep the bromide concentration constant.

The two major variables are (a) the size of the film and (b) the amount of developed silver in the emulsion. Calculation showed that the average amount of silver per film per hanger was substantially constant over similar periods of time.

Each film liberated into the developer a mass of bromide which was substantially constant and equivalent to 0.25 gm. of potassium bromide.

These results indicated that the bromide concentration might be kept constant by: (1) the addition to the tank of 18 ml. of bromide-free developer ("replenisher") for each film to restore the fluid volume —a process which is termed "replenishment" and (2) replacing with more "replenisher" that volume of developer which contains the excess of the liberated bromide, *i.e.* 27 ml. per film; this process is termed "regeneration."

The most suitable means of testing that the activity of the developing solution remains within acceptable limits is by the use of a sensitometric strip. This test film is processed daily and the results compared. Densities are measured with a photoelectric densitometer. This instrument is calibrated by means of density strips that have been measured on a Western Electric densitometer.

Volumetric analysis of samples taken from the developer solution in use is carried out using methods employed in the cinematographic film processing industry.

Increase in the bromide concentration from 0 to 1 gm. per liter produces a marked reduction in fog density. This continues at a slower rate until at 5 gm. per liter the density has fallen to a value which thereafter changes by an insignificant amount even up to concentrations as high as 85 gm. per liter.

Increasing *p*H causes a steady increase in fog density. This is a second order effect as compared with that due to the bromide changes.

The most desirable factor to control in order to achieve constancy of activity would be the bromide concentration.

Few hospitals possess the necessary facilities to undertake the type of analytical work on which this method of developer control is based. The application of the method depends upon the use of a developer having the same constituents in the same or very similar concentrations to those quoted in the paper and also upon there being no long runs of "off-average" films. The ideal conditions are those obtained in a radiologic department concerned with one type of examination and one size of film, for example, roentgenography of the chest.

In the main the four years' experience has been with an automatic plant.—*Stephen N. Tager, M.D*

RADIATION THERAPY

Fowler, Fred D., Alexander, Eben, Jr., and Davis, Courtland H., Jr. Pinealoma with metastases in the central nervous system; a rationale of treatment. *J. Neurosurg.*, May, 1956, *13*, 271–288. (From: Section of Neurosurgery, Department of Surgery, Bowman Gray School of Medicine, Winston-Salem, North Carolina.)

Three cases are presented illustrating the spread of pineal tumors by means of the cerebrospinal fluid to other parts of the nervous system. Regarding treatment, it is suggested that the method of choice be operative decompression followed by irradiation of the complete cerebrospinal axis.

The histologic similarity between pinealoma and medulloblastoma and pinealoma and teratoma is noted. These tumors have a tendency to seed themselves in the posterior wall and floor of the third ventricle and then be carried by the cerebrospinal fluid to other areas in the brain and spinal cord.

Attempts at surgical removal of these tumors have been carried out in the past with unsuccessful results and high mortality. The present generally accepted method of treatment is to relieve increased intracranial pressure by ventriculo-cysternostomy or subtemporal decompression. This is followed by roentgen therapy to the posterior portion of the third ventricle. A biopsy cannot usually be obtained when less radical surgery is utilized and often when attempted may have fatal consequences. It is suggested that, even though a microscopic diagnosis can rarely be made, all patients demonstrating a lesion in the posterior portion of the third ventricle receive palliative irradiation to the complete nervous system.

Ventriculographic examination carried out on the authors' series revealed a mass in the posterior portion of the third ventricle with no filling of the fourth ventricle suggesting obstruction in the aqueduct of Sylvius. Metastatic lesions in the spinal cord were demonstrated by myelography revealing intrathecal filling defects.—*Wallace M. Roy, M.D.*

Ross, Donald E. (Los Angeles, Calif.) Cancer of the thyroid gland. *Surg., Gynec. & Obst.*, Aug., 1956, *103*, 171–179.

Forty cases of surgically proved thyroid cancer were observed in a total of 1,000 thyroidectomies in the series presented.

It is emphasized that regardless of cell type, all malignant thyroid neoplasms are potentially fatal and should be attacked vigorously. Total thyroidec-

tomy and block cervical lymph node dissection on the side of the cancer are minimal requirements for adequate surgery. If positive lymph nodes are found on the affected side, a similar dissection should be performed on the opposite side. Residual thyroid tissue in the neck should then be ablated with radioactive iodine. Any metastases will subsequently be more apt to take up I^{131} because of activation by thyrotrophic hormone.

The sole use of I^{131} in thyroid cancer is deplored.

Detailed statistics of the author's 40 cases are presented in 7 tables. Several case histories and thyrograms are detailed.—*Dale W. Undem, M.D*

UHLMANN, ERICH M. Cancer of the thyroid and irradiation. *J.A.M.A.*, June 9, 1956, *161*, 504–507. (Address: 29th Street and Ellis Avenue, Chicago, Ill.)

A proposed relationship between carcinoma of the thyroid in children and previous roentgen therapy to the head, neck or upper chest region has received considerable attention in recent medical and lay literature. It is the author's contention that no proof of such a correlation between the two events exists. The author's personal experience relative to this matter is presented and further material from the large body of medical literature pertinent to this subject is cited.

In addition to the experience of the author and of numerous other workers, the following is presented in support of the author's view:

1. Whereas radiation to the head, neck and upper chest area is given about equally to the two sexes, carcinoma of the thyroid in children occurs more frequently in girls.

2. The increase in incidence of carcinoma of the thyroid does not parallel the frequency (historically) of treatment of the head, neck and upper chest.

3. A correlation between carcinoma of the thyroid and previous roentgen irradiation has not been established in laboratory animals.

4. In some instances, patients have had unrecognized thyroid carcinoma at the time of initial referral for roentgen therapy which contributes a false apparent relationship.

5. Experimental evidence shows a dosage to thyroid in the treatment of hypertrophic lymphatic tissue in the pharynx and tonsils of 18 roentgens over a two week period, which is very much less than dosage associated with carcinoma following therapy in other areas. It is also less than thyroid dosage in a large percentage of diagnostic fluoroscopic examinations of the chest as determined by experimental measurements.

In summarization of his brief, but excellent, presentation of a large volume of material related to the subject, the author states that "statistically, the correlation of irradiation and carcinoma of the thyroid is untenable."—*John T. McLelland, M.D.*

GARLAND, L. H., and SISSON, M. A. The results of radiotherapy of bronchial cancer. *Radiology*, July, 1956, *67*, 48–62. (Address: L. H. Garland, 450 Sutter Street, San Francisco 8, Calif.)

The authors present the results of studies to determine the efficacy of radiation therapy in bronchial cancer. Two groups of cases were studied: (1) patients seen at the San Francisco Hospital during the last two and a half decades; and (2) patients seen in private practice during the last decade.

Group one consisted of 520 patients with sufficient data available for analysis. Definitive treatment was given to 144 of these patients as follows: surgical treatment, 61; radiation therapy, 67; and exploratory surgery followed by radiation therapy, 16.

Radiation therapy cases were treated as follows: palliative course (less than 1,500 r tumor dose in four weeks), 39; moderate course (1,500–3,000 r tumor dose in four weeks), 33; and more radical course (3,500–5,000 r tumor dose in four to six weeks), 9.

All of the 41 private patients received radiation therapy as follows: palliative only (less than 1,500 r), 4; moderate course (1,500–3,000 r), 32; and more radical course (over 3,000 r), 5.

In most instances a "moderate course" of radiation therapy was planned, i.e. to deliver about 3,000 r throughout the tumor and lymph node area in about four weeks time. Technical factors were: 200–250 kv., with filtration to give a half value layer of from 1 to 2 mm. copper, skin fields of from 10 $\times$10 to 20$\times$20 cm. Multiple small fields were used for the larger dosage, 2 to 4 fields for palliative or moderate dosage.

The average period of survival after treatment in the 81 cases from the San Francisco Hospital was 5.3 months with a range of one to 36 months. In the 41 cases treated in private practice the average survival time was 8.3 months, with a range of one to 19 months, excepting one patient who survived five years and is not included in this series.

Cough was relieved in approximately 60 per cent of the cases, pain in 60 per cent, hemoptysis in 75 per cent, and mediastinal obstruction in 50 per cent. In no case were symptoms made worse by treatment.

It is concluded that radiation therapy with moderately heavy dosage (about 3,000 r tumor dose in four weeks or less) has a useful place in the palliative treatment of bronchogenic carcinoma. With heavy dosage (5,000 r tumor dose in four or five weeks) it is occasionally curative. Results were slightly better in patients with anaplastic tumors than in those with squamous-cell growths, but response to radiation therapy was not predicatable on histologic grounds. Judging from the reports of supervoltage and betatron therapy to date, the results of orthovoltage therapy (200–250 kv.) are of about the same order of effectiveness.—*A. W. Sommer, M.D.*

SUBJECT INDEX TO VOLUME 76

(ab) = abstract (E) = editorial

Abdomen, acute; plain radiography of abdomen in pediatric practice (ab), 424
acute; radiological help in diagnosis of abdominal emergencies (ab), 423
acute; value and limitations of radiology in acute abdominal conditions (ab), 422
use of intravenous cholangiocholecystography in diagnosis of acute conditions of (ab), 628
Abdominal and retroperitoneal viscera, trauma to, as it concerns radiologist (ab), 434
aorta, clinical picture of aneurysm of (ab), 1193
aortic aneurysms, importance of aortography in diagnosis of (ab), 1026
disorders, certain, roentgen findings in, 127
tumors, large, of childhood (other than Wilms' tumor or neuroblastoma) (ab), 1188
venography in urological diagnosis (ab), 844
venography; technique of roentgen visualization of inferior vena cava, 807
Accelerator, linear electron, as source of fast electrons for cancer therapy (ab), 1030
8 mev. linear, medical research council, preliminary report on clinical use of (ab), 1030
Achalasia; anatomy of cardia as it relates to regional pathophysiology (ab), 1185
Adenocarcinoma of rectum, primary treatment of, by high voltage roentgen rays (1,000 kv.), 919
Adenomas, pleomorphic (mixed tumors of salivary glands) (ab), 652
Agenesis of odontoid process (ab), 1191
Air, free intraperitoneal, 143
insufflation of colon as aid in diagnosis of cholelithiasis (ab), 630
Alimentary tract, sarcoidosis of (ab), 426
American Board of Radiology announces examinations, 819
American Radium Society, Annual Meeting of (E), 396
American Roentgen Ray Society
Commercial Exhibit, 1179
Fifty-seventh Annual Meeting of (E), 179; (E), 1167
Preliminary Program, 188
Scientific Exhibit, 1172
Section on Instruction, 398
American Roentgen Ray Society, historical sketch—"Lest we forget," 1
Amyloid disease (ab), 846
Aneurysm of abdominal aorta, clinical picture of (ab), 1193
of anomalous right subclavian artery (ab), 844
Aneurysms, abdominal aortic, importance of aortography in diagnosis of (ab), 1026
of sinus of Valsalva, 767
Angiocardiographic observations of intracardiac flow in the normal and in mitral stenosis (ab), 638
Angiocardiographies and vasographies, application of Odelca roentgen camera for (ab), 637
Angiocardiography, rapid serial, in erect position, device for, 801
selective, in infants and children (ab), 639
Angiographic examinations with Odelca mirror camera of medium size; indirect roentgen cinematography of cerebral vessels (ab), 637
Angiography, cerebral, photofluorography (medium size) for (ab), 201
cerebral simultaneous serial, on 70×70 mm. frame (experiences with Odelca-Camera) (ab), 1182
percutaneous cerebral, technique in, 804
percutaneous selective, of main branches of aorta (ab), 638
portable shield for radiation protection during (ab), 1026
selective, of abdominal aorta with guided catheter (ab), 638
serial long film, in arteriosclerosis obliterans, technique of, 787
Angiopac, ethyl di-iodostearate as hepatosplenographic agent, 39
Angiopneumography, selective, and correlative study of bronchography and histopathologic findings in tuberculous fibrothorax (ab), 202
Ankle, fracture dislocation of, with fixed displacement of fibula behind tibia, 1102
Aorta, abdominal, coarctation of; report of case illustrating value of aortography as diagnostic aid, 782
abdominal, selective angiography of, with guided catheter (ab), 638
coarctation of, value of laminagraphy in diagnosis and evaluation of, 773
percutaneous selective angiography of main branches of (ab), 638
Aortic arch, left, and right descending aorta; case report, 762
arch, right, and right-sided descending aorta, with bilateral ductus arteriosus; report of case, 758
Aorto-diastolic displacement or systolic expansion; roentgenkymographic study of left atrial movements in mitral cardiopathy (ab), 1021
Aortography, importance of, in diagnosis of abdominal aortic aneurysms (ab), 1026

in dogs, spinal cord lesions produced by (ab), 433
in localization of pheochromocytoma, danger of (ab), 1193
retrograde, demonstration by, of multiple pregnancies in dog, 813
APPRECIATION, word of (E), 606
ARTERIOGRAPHY, pelvic, value of, in diagnosis of mole and chorionepithelioma (ab), 631
ARTERIOSCLEROSIS obliterans, technique of serial long film angiography in, 787
ARTERIOVENOUS communications, congenital peripheral, roentgenographic manifestations of (ab), 1193
ARTERY, renal, percutaneous catheterization of (ab), 638
ARTHRITIS in elderly patient (osteoarthritis) (ab), 431
rheumatoid, protrusio acetabuli (ab), 432
ARTHROSES of hip (ab), 844
ASCARIASIS, intestinal, in children, roentgenographic demonstration of, without using barium, 558
ASPERGILLOMA of lung (ab), 1184
ATELECTASIS of right upper lobe or hyperplasia of thymus? Reply to remarks of Lasar Dünner on subject of paramediastinal shadow (ab), 205
thymus, or mediastinal effusion? (ab), 206
ATLANTO-AXIAL JOINT, examination of, following injury; with particular emphasis on rotational subluxation, 1081
ATOMIC ENERGY INDUSTRY, radiation protection in (ab), 213
ATRIAL septal defect, ostium secundum, roentgen aspects of (ab), 204
Au^{198}, colloidal, histopathological study of lymph nodes irradiated with (ab), 212
experimental study of intramammary injection of (ab), 1032
AUDITORY ossicles and tympanic cavity, 327
AURICLES, normal and abnormal right, electrokymographic studies of; with special reference to changes in atrial septal defect and valvular pulmonary stenosis (ab), 625

B^{10} (n, α) Li reaction, energy deposition in tissue by neutrons of various energies and, 372
BARIDOL and pro-banthine, use of, in visualization of mucosal pattern of small intestine (ab), 833
BARIUM enema examination of incontinent patients, note on (ab), 834
sulfate, agglomeration of, and roentgen visualization of gastric mucosa (ab), 1185
BASILAR impression (ab), 1018
BEAM defining systems for medium distance teletherapy units, physical requirements of (ab), 650
quality determinations for a 2-Mvp resonance type x-ray generator (ab), 848
BETA radiation, effects of, on eye (ab), 641
-ray applicators, construction and measurement of, for use in ophthalmology (ab), 644
sources, dosimetry of, in tissue; point-source function (ab), 650
BETATRON irradiation, clinical aspects of, 905
therapy, field localization for, 934
BILIARY and pancreatic ducts, radiographic and other studies of (ab), 428
fistulas, spontaneous internal, and gallstone ileus, roentgen diagnosis of (ab), 630
pathways, observations on (ab), 427
BISMUTH-206, pure gamma-emitter for therapy (ab), 1034
BLADDER, full, effect of, in hystero-salpingography (ab), 630
tumors, use of radioactive cobalt in nylon sutures in treatment of (ab), 436
BLALOCK-TAUSSIG operation, rib notching following (ab), 1185
BLOOD DYSCRASIAS and malignant lymphoma, treatment of, by conventional roentgen therapy, 960
BLOOD-VOLUME measurements in cancer using Cr^{51} red-blood-cell tagging method (ab), 1032
BONE, benign chondroblastoma of; its roentgen diagnosis, 1132
cyst, aneurysmal (ab), 1026
fibrous dysplasia of; analysis of 15 cases of surgically verified costal fibrous dysplasia (ab), 842
giant cell tumor of (ab), 635
hyoid, fracture of, 1144
occurrence of metastasis of bronchogenic carcinoma to; report of case with osteoblastic metastasis, 81
phantom bone, disappearing bone, acute spontaneous absorption of (massive osteolysis) (ab), 635
solitary myeloma of, 972
tumors, benign conditions simulating (ab), 430
BONES, multangular, ossification of (ab), 430
BOOK REVIEWS
Surgery of the Elbow. By Frederick M. Smith, 192
Klinische Fehldiagnosen. By M. Bürger, 192
Obstetrical Roentgenology. By Robert Berman, 192
Maladies des Os et des Articulations. By Stanislas de Sèze and Antoine Ryckewaert, 193
Fundamentals of Radiobiology. By Z. M. Bacq and Peter Alexander, 193
Recent Advances in Radiology. By Thomas Lodge, 194
Pathology for the Surgeon, By William Boyd, 194
Obstetrics. By J. P. Greenhill, 195
Atlas of Roentgen Anatomy of the Skull. By Lewis E. Etter, J. Brown Farrior, Samuel G. Henderson and Louise S. Sherman, 413

Die Occipito-Cervical-Gegend; Eine diagnostisch-pathogenetische Studie. By J. E. W. Brocher, 413
Radiodiagnostic en Ophtalmologie. By Edward Hartmann and Evelyn Gilles, 413
Surgical Forum; Proceedings of the Forum Sessions, Fortieth Clinical Congress of the American College of Surgeons, Atlantic City, N. J., November, 1954. By Committee on Forum on Fundamental Surgical Problems, Harris B. Shumacker, Jr., Chairman, 414
Clinical Approach to Jaundice. By Leon Schiff, 414
Sympathikus Chirurgie. By Paul Sunder-Plassmann, 415
Radiographic Atlas of Skeletal Development of the Knee. By S. Idell Pyle and Normand L. Hoerr, 415
The Joints of the Extremities. By Raymond W. Lewis, 416
Primeiros ensaios de radioterapia microlocalizada da hipófise e do hipotálamo. By Carlos Santos, 416
Angiographic Localization of Intracranial Masses. By Arthur Ecker and Paul A. Riemenschneider, 416
Hyperostosis Cranii. By Sherwood Moore, 417
The Abnormal Pneumoencephalogram. By Leo M. Davidoff and Bernard S. Epstein, 417
The Year Book of Radiology. Edited by John Floyd Holt, Fred Jenner Hodges, Harold W. Jacox and Morton M. Kligerman, 418
Pediatric X-Ray Diagnosis. By John Caffey, 612
Herzkrankheiten im Säuglingsalter. By Ettore Rossi, 613
Legg-Calvé-Perthes Syndrome and Related Osteochondroses of Youth. By Charles Weer Goff, 613
Die genuine Vitamin D-resistente Rachitis. By Walter Swoboda, 613
Intestinal Obstructions. By Owen H. Wangensteen, 614
Roentgen Interpretation. By George W. Holmes and Laurence L. Robbins, 614
Differentialdiagnostik der Lungenkrankheiten. By Lasar Dünner, 615
La Bronchografia. By Dario Gandini, 616
Atlas of Bronchial Lesions in Pulmonary Tuberculosis; A Clinical and Morbid-Anatomical Study. By C. Dijkstra, 616
Fluoroscopy in Diagnostic Roentgenology. By Otto Deutschberger, 616
The Auxiliary Heart. By William Walter Wasson, 820
Studies in Hypertensive Cardiovascular Disease with Special Reference to Cardiac Function. The Scandinavian Journal of Clinical and Laboratory Investigation, Supplement 17. By Edvardas Varnauskas, 820
Diagnosis of Congenital Heart Disease. By Sven R. Kjellberg, 821
Die Röntgen-Untersuchung des Herzens und der Grossen Gefässe. By R. Janker, Grosse-Brockhoff, R. Haubrich, H. Lotzkes, A. Schaede and H. Hallerbach, 822
Cardiac Diagnosis; A Physiologic Approach. By Robert F. Rushmer, 822
Hämodynamik des Herzens im Röntgenbild, mit besonderer Berücksichtigung der Herzkatheterisierung und der Angiokardiographie. By P. Thurn, 823
Electrokymography; With Special Reference to Valvular, Pulmonary and Infundibular Stenosis. Acta radiologica, Supplement 134. By Ulf Rudhe, 823
Peripheral Vascular Diseases. By Edgar V. Allen, Nelson W. Barker and Edgar A. Hines, Jr., 823
Klinische Electrokardiographie. By M. Holzmann, 824
Pathologic Physiology; Mechanisms of Disease. Edited by William A. Sodeman, 824
Radiology for Medical Students. By Fred Jenner Hodges, Isadore Lampe and John Floyd Holt, 825
Annual Review of Medicine. Volume 6. 1955. Edited by David A. Rytand, 825
A. Liechti—Röntgenphysik. By Walter Minder, 1010
The Microstructure of Starch Grains. By Edith A. Roberts, 1011
Breast Cancer and Its Diagnosis and Treatment. By Edward F. Lewison, 1011
Small-Angle Scattering of X-Rays. By André Guinier and Gérard Fournet, 1011
Nuclear Radiation Detectors. By J. Sharpe, 1012
Trabajos de Oncología y Radioterapia, Años 1953–1954. By Alfonso C. Frangella, 1012
Autoradiography in Biology and Medicine. By George A. Boyd, 1013
Causal Factors in Cancer of the Lung. By Carl V. Weller, 1013
Symposium on Genetic Recombination. Sponsored by The Biology Division, Oak Ridge National Laboratory, 1013
Biological Hazards of Atomic Energy; Being the Papers Read at the Conference Convened by the Institute of Biology and Atomic Scientists' Association, October, 1950. Edited by A. Haddow, 1014
Handbook of Radiology. Edited by Russell H. Morgan and Kenneth E. Corrigan, 1015
Bowel, small segmental infarction of (ab), 833
Brain, roentgenographic signs of tumors of, 226
tumors, possible use of neutron capturing isotope lithium^6 in radiation therapy of, 376
Breast, calcification in secretory disease of, 132

care of patient with advanced cancer of (ab), 435
normal, and breast tumors, uptake of radioactive phosphorus in (ab), 648
BRONCHIAL CANCER, results of radiotherapy of (ab), 1196
BRONCHOGENIC CARCINOMA, peripheral, roentgenologic evidence of calcification in (ab), 1184
BRONCHOGRAPHIC TECHNIQUE, contribution to (ab), 1184
BRONCHOGRAPHY, dionosil in (ab), 202
selective angiopneumography and correlative study of, and histopathologic findings in tuberculous fibrothorax (ab), 202
BURNS, thermal flash, influence of x-radiation on mortality following; site of tissue injury as factor determining type of invading bacteria (ab), 215

CAISSON DISEASE, roentgen manifestations of, 74
CALCAREOUS DEPOSITS of supraspinatus tendinitis, excavation of humeral head by (ab), 634
CALCIFICATION in secretory disease of breast, 132
outlining cerebral ventricles, cytomegalic inclusion disease with, 512
unilateral, of choroid plexus in child (ab), 622
CALCIFICATIONS, splenic, incidence of, in positive reactors to histoplasmin and tuberculin, 53
CANCER, advanced, of breast, care of patient with (ab), 435
blood-volume measurements in, using Cr^{51} red-blood-cell tagging method (ab), 1032
bronchial, results of radiotherapy of (ab), 1196
cervical, clinical relationship of radiology and gynecology in treatment of (ab), 641
cervical, review of seventeen years' experience with transvaginal roentgen therapy in, 965
lung, treatment of, with radiation and radiomimetic drugs (ab), 1029
of thyroid and irradiation (ab), 1196
of thyroid gland (ab), 1195
therapy, linear electron accelerator as source of fast electrons for (ab), 1030
use of supervoltages and large masses of radioelements in treatment of, in general (ab), 847
CAPSULE, visualization of, with thorium dioxide; subdural collections of fluid in infants and children, 507
CARCINOMA, bronchogenic, occurrence of metastasis of, to bone; report of case with osteoblastic metastasis, 81
of cervix, radioactive gold for intracavitary treatment of (ab), 211
of endometrium as modified by prior surgery and post-irradiation hysterosalpingo-oophorectomy, comparative radiotherapeutic results in (ab), 1027
of larynx, 942
of posterior tongue treated with radiation (ab), 1028
of prostate, present status of treatment of, with radioactive materials (ab), 1033
of trachea (ab), 435
of uterus, pelvic metastases and involvement of parametria from (ab), 1023
metastatic, of thyroid, serum I^{131} fractionation in; fate of endogenous radiothyroxine after I^{131} therapy (ab), 210
metastatic thyroid, evaluation of various factors influencing treatment of, with I^{131} (ab), 646
squamous cell, of thoracic esophagus, 949
recurrent, of colon at site of anastomosis; roentgen observations (ab), 834
CARDIO-ESOPHAGEAL relaxation (chalasia) studies on normal infant, 540
CARDIOPATHY, mitral, roentgenkymographic study of left atrial movements in; systolic expansion or aorto-diastolic displacement (ab), 1021
CARDIOSPASM, lipoid (mineral oil) pneumonia and cor pulmonale due to, 108
CARDIO-THORACIC RATIO in roentgenography of normal pregnant patient, 64
CARDIOVASCULAR radiology, expanding scope of, 721
roentgenology, new horizons in (E), 817
roentgenology, sixty years of, 657
surgery, accomplishments and possibilities in, 730
CARPAL BOSS (ab), 634
CARTILAGINOUS series, tumors of (ab), 430
CASSETTES, x-ray, effective method of permanently marking, with radiopaque material (ab), 654
CEREBRAL angiography, percutaneous, technique in, 804
angiography, photofluorography (medium size) for (ab), 201
ventricles, cytomegalic inclusion disease with calcification outlining, 512
vessels, indirect roentgen cinematography of; angiographic examinations with Odelca mirror camera of medium size (ab), 637
CERVICAL exostoses, massive, hoarseness and painful deglutition due to (ab), 1019
CERVIX, radioactive gold for intracavitary treatment of carcinoma of (ab), 211
CHALASIA (cardio-esophageal relaxation) studies on normal infant, 540
CHARCOT JOINTS, diabetic (ab), 1193
CHELATION in contrast roentgenography with special reference to lead disodium EDTA, 161
CHICKENPOX PNEUMONIA; case report (ab), 830
primary, 527
roentgen findings in, 533
CHILDHOOD, idiopathic coxa vara in (ab), 1192
large abdominal tumors of (other than Wilm's tumor or neuroblastoma) (ab), 1188
CHILDREN, congenital urinary tract obstruction in (ab), 838
cystography in (ab), 837

young, multiple skeletal lesions in, due to trauma (ab), 1190
Cholangiocholecystography, intravenous, use of, in diagnosis of acute conditions of abdomen (ab), 628
Cholangiography, body-section, with new intravenous medium (cholografin) (ab), 427
Cholecystangiography, basic combined (ab), 1188
Cholecystitis, weak or absent opacification of gallbladder and diagnosis of (ab), 834
Cholecystocholangiography, intravenous; cholografin, new intravenously administered contrast medium for visualization of gallbladder and bile ducts, 7
Cholecystographic visualization of Rokitansky-Aschoff sinuses; report of case and review of literature (ab), 835
Cholecystography and pyelography, combined intravenous (ab), 1187
during lactation (ab), 1188
oral, evaluation of, in liver disease (ab), 835
reliability of (ab), 629
telepaque, re-evaluation of fat-free preparatory meal in, 21
Cholecystostomy, effect of, upon subsequent roentgenologic appearance of gallbladder (ab), 630
Cholelithiasis, air insufflation of colon as aid in diagnosis of (ab), 630
hiatus hernia and diverticulosis of colon (Saint's triad) (ab), 628
relationship of, to sickle cell crises (ab), 836
Cholografin methylglucamine (ab), 835
new intravenous medium, body-section cholangiography with (ab), 427
new intravenously administered contrast medium for visualization of gallbladder and bile ducts (intravenous cholecystocholangiography) with report on 104 cases, 7
Chondroblastoma, benign, of bone; its roentgen diagnosis, 1132
Chondroma, periosteal (ab), 636
Chorionepithelioma and mole, value of pelvic arteriography in diagnosis of (ab), 631
Choroid plexus in child, unilateral calcification of (ab), 622
Chromate cancer of lungs and benign lung tumors in chromate workers (ab), 623
Cinematography, indirect roentgen, of cerebral vessels; angiographic examinations with Odelca mirror camera of medium size (ab), 637
Cinemicrographic observations and theoretical considerations on reactions of lymphocytes to x-rays (ab), 216
Coarctation of abdominal aorta; report of case illustrating value of aortography as diagnostic aid, 782
of aorta, value of laminagraphy in diagnosis and evaluation of, 773
Cobalt^{60} gamma radiation and roentgen rays with half-value layers from 1 mm. Al to 5 mm. Cu, absorption in different tissues of (ab), 649
-labeled vitamin B_{12} urine test, clinical application of (ab), 210
protection design (ab), 209
radiation sources, current techniques in handling and distribution of (ab), 1036
telecurie therapy, some observations on clinical effects of, 895
Coccidioidomycosis, osseous; chronic form of dissemination, 1052
Colloidal $As_2{}^{76}S_3$. Its production and possible use in treatment of papillomatosis of urinary bladder (ab), 645
Colon, air insufflation of, as aid in diagnosis of cholelithiasis (ab), 630
diverticulosis of, hiatus hernia and cholelithiasis (Saint's triad) (ab), 628
multiple polyposis of, osteomatosis and soft-tissue tumors; report of familial syndrome (ab), 628
recurrent carcinoma of, at site of anastomosis; roentgen observations (ab), 834
Congenital absence of pectoral muscle, 599
Cor pulmonale and lipoid (mineral oil) pneumonia due to cardiospasm, 108
Cortical hyperostosis, infantile (ab), 841
Coxa vara, idiopathic, in childhood (ab), 1192
Cr^{51} red-blood-cell tagging method, blood-volume measurements in cancer using (ab), 1032
Cranial manifestations of familial metaphyseal dysplasia (ab), 622
Cryptococcosis, pulmonary (ab), 624
Cushing's disease; its roentgenographic findings (ab), 1183
Cysteamine, cystamine and hypoxia, effect of, on mortality and bone marrow chromosome aberrations in mice after total body roentgen irradiation (ab), 212
Cystic adenomatoid malformation of lung, congenital, in infants, 516
Cystitis emphysematosa associated with hemochromatosis with diabetes (ab), 840
Cystography, delayed, and voiding cystoureterography (ab), 429
in children (ab), 837
Cystoureterography, voiding, and delayed cystography (ab), 429
Cysts, dermoid, of ovary; roentgen features (ab), 837
sacral myelographic appearance of (ab), 632
Cytomegalic inclusion disease with calcification outlining cerebral ventricles, 512

Dextroversion, uncomplicated, of heart (ab), 204
Diabetic Charcot joints (ab), 1193
pneumaturia (ab), 839
Diarrhea, deficiency of intestinal gas in infants with (ab), 425

Digestive tract, upper, clinical findings in foreign bodies of respiratory and (ab), 207
Dionosil in bronchography (ab), 202
Diskography (nucleography), roentgen diagnosis of herniated disk with particular reference to, 290
Dosage data for 4,000,000 volt x rays (ab), 1029
in human thyroid glands, quantitative autoradiographic study of radioiodine distribution and (ab), 645
problems in radiotherapy, applications of Mayneord contour projector to (ab), 642
Dose distribution, radiation, in water for 22.5-mev.-peak roentgen rays (ab), 643
-time studies in irradiation of mycosis fungoides; iso-effect curve and tumor lethal dose (ab), 642
thyroid, from radioiodine in fallout (ab), 649
Doses, tissue, calculation of, and data for production of isodose charts, using standard depth-dose tables (ab), 655
Dosimeter, scintillation crystal roentgen-ray, 979
Dosimetry and relative biologic effectiveness (appendix), 893
of beta sources in tissue; point-source function (ab), 650
Dramamine and pyridoxine, study of effectiveness of, on clinical radiation sickness (ab), 643
Ductography, operative thoracic (ab), 207
Ductus arteriosus, bilateral, with right aortic arch and right-sided descending aorta; report of case, 758
Duodenal biopsy by aspiration under fluoroscopic control (ab), 422
bulb, gallstone obturation of, 24
loop changes in posterior penetration of duodenal ulcer (ab), 1187
stenosis in sucklings and infants as result of adhesions and volvulus, radiologic study of (ab), 832
ulcer, duodenal loop changes in posterior penetration of (ab), 1187
Duodenum, hematoma of (ab), 1022
Dysostosis, metaphyseal hereditary, 569
Dysplasia, familial metaphyseal, cranial manifestations of (ab), 622
fibrous, of skull with sarcoma, 320

Editorials
Fifty years of progress, 177
Fifty-seventh Annual Meeting of the American Roentgen Ray Society, 179
Lyell Cary Kinney, 1884–1956, 180
Jack Friedman, 1911–1955, 182
Roentgenology in relation to neurological surgery, 394
The Annual Meeting of the American Radium Society, 396
A word of appreciation, 606
New horizons in cardiovascular roentgenology, 817
Roentgen therapy, 1002
The Fifty-seventh Annual Meeting of the American Roentgen Ray Society, 1167
EDTA, lead disodium, chelation in contrast roentgenography with special reference to, 161
Electrokymographic studies of normal and abnormal right auricles; with special reference to changes in atrial septal defect and valvular pulmonary stenosis (ab), 625
Electrokymography in pathologic densities of mediastinum and in proximity of hilus (ab), 1185
Embolism, gas, roentgenologic considerations, including experimental use of carbon dioxideas an intracardiac contrast material (ab), 845
Embryoma of kidney, bilateral; patient alive and well three years after treatment (ab), 1190
Endometrium, carcinoma of, as modified by prior surgery and post-irradiation hysterosalpingo-oophorectomy, comparative radiotherapeutic results in (ab), 1027
Energy levels, higher than 1–3 mev., clinical program to evaluate practical significance of, 866
Epidermoids, intracranial (so-called cholesteatomas), roentgen diagnosis of (ab), 829
primary, of skull, including case with malignant change, 1076
Esophageal kymography; does it have preoperative significance for thoracic surgeon? (ab), 208
web, lower (ab), 208
Esophagus, pathologic physiology of lower end of, in special relation with hiatus hernias (ab), 208
thoracic, squamous cell carcinoma of, 949
Ewing's sarcoma; its roentgen classification and diagnosis (ab), 843
Eye, effects of beta radiation on (ab), 641
Eyelids, malignant tumors of (ab), 434

Femoral neck, fracture of, following irradiation of pelvis (ab), 1031
method of measuring, in surgical treatment of fractures of hip, 1163
Fetal damage, intrauterine, by roentgen rays (ab), 1031
Fetus, occurrence of free gas in, in cases of intrauterine death (ab), 1188
Fibrin body in old abscess cavity, simulating new growth (ab), 847
Fibrothorax, tuberculous, selective angiopneumography and correlative study of bronchography and histopathologic findings in (ab), 202
Fibrous dysplasia of bone; analysis of 15 cases of surgically verified costal fibrous dysplasia (ab), 842
Field localization for betatron therapy, 934
mapping device, automatic, 939
Fifty years of progress (E), 177

Film dosimetry, revised technique for, at Oak Ridge National Laboratory (ab), 654
Fistulas, spontaneous internal biliary, and gallstone ileus, roentgen diagnosis of (ab), 630
Fluorescent badges for use during fluoroscopy (ab), 214
Fluoroscopic control, duodenal biopsy by aspiration under (ab), 422
Fluoroscopy, fluorescent badges for use during (ab), 214
Foreign bodies of respiratory and upper digestive tract, clinical findings in (ab), 207
Foreign body cyst, large, with migration of Smith-Petersen nail, 1070
Fracture dislocation of ankle with fixed displacement of fibula behind tibia, 1102
medial clavicular, unusual sequela following pinning of, 1066
of femoral neck following irradiation of pelvis (ab), 1031
of hyoid bone, 1144
-transfixing pin, migration of, from humerus into mediastinum, 1061
Fractures of hip, method for measuring femoral neck in surgical treatment of, 1163
Friedman, Jack, 1911–1955, obituary, 182
portrait, 182

Gallbladder and bile ducts, new intravenously administered contrast medium for visualization of (cholografin), 7
effect of cholecystostomy upon subsequent roentgenologic appearance of (ab), 630
experiences with upright fluoroscopic spot-film examination of (ab), 1187
volumetric evaluation of emptying of (ab), 1022
weak or absent opacification of, and diagnosis of cholecystitis (ab), 834
Gallstone ileus, roentgen diagnosis of spontaneous internal biliary fistulas and (ab), 630
obturation of duodenal bulb, 24
Gamma-emitter, pure, bismuth–206, for therapy (ab), 1034
radiation exposures from fallout following nuclear detonations, criteria for evaluating (ab), 656
-ray applicators, tantalum 182 wire, for use in ophthalmology (ab), 644
Gas embolism, roentgenologic considerations, including experimental use of carbon dioxide as intracardiac contrast material (ab), 845
free, in fetus in cases of intra-uterine death, occurrence of (ab), 1188
or vacuum phenomenon in pubic symphysis during pregnancy (ab), 836
Gastric granuloma with eosinophilic infiltration (ab), 627
leiomyomas and leiomyosarcomas, roentgen findings in (ab), 1186
lipoma; case report (ab), 1187
Gastrointestinal examination, water-soluble, nonabsorbable radiopaque mediums in (ab), 422
tract, roentgen diagnosis of fruit pits in, 136
tract, teaching aids for instruction in radiologic study of (ab), 626
tract, upper, early roentgen examination in massive bleeding of (ab), 626
Giant cell tumor of bone (ab), 635
Glioma of optic nerves and chiasm, value of radiation therapy in management of (ab), 848
Gliomas, experimentally induced, effect of single doses of roentgen radiation on, 351
Glomus jugulare tumors; clinical and radiological features (ab), 633
Gout as cause of isolated circumscribed cyst of patella (ab), 635
Granuloma, eosinophilic, of lung (ab), 203
with eosinophils; benign inflammatory fibroid polyps of stomach (ab), 627
Granulomatosis, Wegener's, and periarteritis nodosa, circumscribed pulmonary lesions in, 88
Grid method in radiation therapy with fast electrons (ab), 1030
Growth rates of human tumors, observations on, 988
Gynecology and radiology, clinical relationship of, in treatment of cervical cancer (ab), 641

Hamartoma with double localization (renal and vertebral); clinical, radiologic and histologic study of rare case of (ab), 640
Head trauma, role of emergency skull roentgenogram in, 315
Heart disease, congenital, roentgen manifestations of pulmonary hypertension in (ab), 831
disease, practical value of posteroanterior roentgenogram and roentgenoscopy in certain types of, 664
disease, rheumatic, cardiac roentgen-ray patterns in; correlation of roentgen and operative findings in 150 consecutive cases; preliminary report, 693
influence of posture on size and configuration of, as seen teleroentgenographically, 706
the doctor and his (ab), 626
uncomplicated dextroversion of (ab), 204
Hemangiomas, ultrasoft roentgen rays in treatment of; follow-up examination of 400 cases of strawberry marks and port-wine stains (ab), 1027
Hematoma of duodenum (ab), 1022
subdural, in infancy (ab), 1182
Hemochromatosis with diabetes, associated with cystitis emphysematosa (ab), 840
Hemosiderosis, recurrent pulmonary hemorrhage with; so-called idiopathic hemosiderosis, 98
Hepatoma, primary, in infants and children, roentgen findings in (ab), 1022
Herniated disk, roentgen diagnosis of, with particular reference to diskography (nucleography), 290

lumbar disk syndrome, lumbar and sacral compression radiculitis (ab), 632
Heterosexual development, roentgenologic investigation of patients with, 562
Hiatus hernia, cholelithiasis and diverticulosis of colon (Saint's triad) (ab), 628
hernias, pathologic physiology of lower end of esophagus, in special relation with (ab), 208
Hip, arthroses of (ab), 844
method of measuring femoral neck in surgical treatment of fractures of, 1163
Histoplasmin and tuberculin, incidence of splenic calcifications in positive reactors to, 53
Histoplasmosis, acute fulminating, 60
Humeral head, excavation of, by calcareous deposits of supraspinatus tendinitis (ab), 634
Humerus, clinical significance of supracondyloid process of, 1154
migration of fracture-transfixing pin from, into mediastinum, 1061
Hydatid cysts of liver, splenoportography in diagnosis of (ab), 1027
Hydronephrosis, intermittent, diagnosis of; importance of pyelography during episodes of pain (ab), 838
Hyoid bone, fracture of, 1144
Hypaque, renografin, and urokon; comparative clinical trial of urographic media (ab), 1024
Hyperostosis, infantile cortical (ab), 1025
report of two cases with review of points of differential diagnosis from hypervitaminosis A, 576
Hyperparathyroidism, radiological manifestations of (ab), 1192
Hyperplasia of thymus or atelectasis of right upper lobe? Reply to remarks of Lasar Dünner on subject of paramediastinal shadow (ab), 205
Hyperthyroidism, leukemia following radioiodine treatment of (ab), 645
radioactive iodine or surgery in treatment of (ab), 210
Hypofibrinogenemia, unusual uterine enlargement caused by bleeding due to, associated with fetal death (ab), 837
Hypothyroid infant and child; role of roentgen evaluation in therapy (ab), 841
Hypoxia, cysteamine and cystamine, effect of, on mortality and bone marrow chromosome aberrations in mice after total body roentgen irradiation (ab), 212
Hystero-salpingography, effect of full bladder in (ab), 630

I^{131}, evaluation of various factors influencing treatment of metastatic thyroid carcinoma with (ab), 646
in patients with varied thyroid function, iodine-concentrating and iodine-secreting capacity of salivary glands investigated with (ab), 646
serum, fractionation in metastatic carcinoma of thyroid; fate of endogenous radiothyroxine after I^{131} therapy (ab), 210
I^{132}, new radioactive isotope, contribution to clinical use of; reproducibility of short-timed radioiodine examinations (ab), 211
Ileum, roentgen examination of distal loop of, in children (ab), 1022
Inclusion disease, cytomegalic, with calcification outlining cerebral ventricles, 512
Incontinent patients, note on barium enema examination of (ab), 834
Infantile cortical hyperostosis (ab), 841; (ab), 1025
report of two cases with review of points of differential diagnosis from hypervitaminosis A, 576
Infarction, segmental, of small bowel (ab), 833
Interpediculate distances, maximum, in adults and children; width of spinal canal in growing vertebra with special reference to sacrum, 476
Intervertebral disk protrusions, involvement of spinal cord by (ab), 840
Intestinal ascariasis in children, roentgenographic demonstration of, without using barium 558
gas, deficiency of, in infants with diarrhea (ab), 425
gas, dehydration and deficiency of, in infants; with hypertrophic pyloric stenosis, 551
injuries from transvaginal irradiation (ab), 1031
lipodystrophy, extraintestinal roentgen manifestations of (ab), 425
Intestine, small, roentgenologic findings of, in 100 repatriated prisoners of war; deficiency states and worm infestations, 149
use of pro-banthine and baridol in visualization of mucosal pattern of (ab), 833
Intra-articular ossicle, secondary ossification centers and, 1095
Intracardiac flow, angiocardiographic observations of, in the normal and in mitral stenosis (ab), 638
Intrathoracic administration to pneumonectomized dogs, lymphatic drainage of silver-coated radioactive gold colloid following (ab), 209
tumors, roentgen examination of, by means of rapid serial exposures (ab), 1020
Intravenous urography, accidents during (ab), 838
Ionization chambers, tissue-equivalent (ab), 652
Irradiation, betatron, clinical aspects of, 905
cancer of thyroid and (ab), 1196
for pituitary tumor, improvement of osseous changes in sella turcica following (ab), 1032
mediastinal lymph node, with radioactive gold (ab), 1033

of animal tumors with roentgen rays, methodical problem in studies of metabolism with P^{32} after (ab), 1036
of mycosis fungoides, time-dose studies in; iso-effect curve and tumor lethal dose (ab), 642
of pelvis, fracture of femoral neck following (ab), 1031
pelvic, management of some late complications of (ab), 436
transvaginal, intestinal injuries from (ab), 1031
Ischial epiphysiolysis, 1161
Ischiopubic synchondrosis in healthy children; some normal roentgenologic findings, 488
Isodose charts, calculation of tissue doses and data for production of, using standard depth-dose tables (ab), 655
curves from 2 mev. Van de Graaff machine, notes on, 929
Iso-effect curve and tumor lethal dose; time-dose studies in irradiation of mycosis fungoides (ab), 642
Isotopes, radioactive, some applications of, in ophthalmology (ab), 644
Isotopic radiographic units, portable, 168

James Picker Foundation awards, 611
funds for research, 819
Jaws, clinical pantomography of (ab), 1018
some aspects of problem of radionecrosis of (ab), 209
Joints, Luschka, of cervical spine (ab), 634

Kidney, bilateral embryoma of; patient alive and well three years after treatment (ab), 1190
polycystic disease of, in infants; nephrograms following intravenous urography, 153
Kinney, Lyell Cary, 1884–1956, obituary, 180
portrait, 180
Knee joint and tibia of six-week-old mice, uptake of phosphorus 32 by, and effect of x-rays upon it; variation of uptake with time after dose of 2000 r of 200 kV x-rays (ab), 648
Kymography, esophageal; does it have preoperative significance for thoracic surgeon? (ab), 208

Lactation, cholecystography during (ab), 1188
Laminagraphy in diagnosis and evaluation of coarctation of aorta, value of, 773
Larynx, carcinoma of, 942
Lesions, predictable subcortical, technique for producing, in brains of laboratory animals; stereotaxic implantation of calibrated Pd^{109} and Y^{90} spheres (ab), 1034
Leukemia, chronic myeloid, treatment of, with colloidal radioactive gold (ab), 647
following radioiodine treatment of hyperthyroidism (ab), 645
Lipodystrophy, intestinal, extraintestinal roentgen manifestations of (ab), 425
Lipoma, gastric, case report (ab), 1187
Lithium^6, neutron capturing isotope, possible use of, in radiation therapy of brain tumors, 376
Liver disease, evaluation of oral cholecystography in (ab), 835
splenoportography in diagnosis of hydatid cysts of (ab), 1027
Los Angeles Radiological Society to entertain radiologists, 191
Lung, aspergilloma of (ab), 1184
cancer, treatment of, with radiation and radiomimetic drugs (ab), 1029
congenital cystic adenomatoid malformation of, in infants, 516
eosinophilic granuloma of (ab), 203
roentgenograms, "hard-ray" technique as routine for (ab), 201
Lungs, chromate cancer of, and benign lung tumors in chromate workers (ab), 623
Luschka joints of cervical spine (ab), 634
Lymphangioma of mediastinum (ab), 626
Lymphatic drainage of silver-coated radioactive gold colloid following intrathoracic administration to pneumonectomized dogs (ab), 209
Lymph node irradiation, mediastinal, with radioactive gold (ab), 1033
Lymph nodes irradiated with colloidal Au^{198}, histopathological study of (ab), 212
Lymphocytes, cinemicrographic observations and theoretical considerations on reactions of, to x-rays (ab), 216
Lymphogranulomatosis, contribution to treatment of (ab), 1028
Lymphoid tissue, some basic concepts regarding tumors of, 956
Lymphoma, malignant, and blood dyscrasias, treatment of, by conventional roentgen therapy, 960
malignant, reflections on, 849
Lymphosarcoma in infancy and childhood, 594
of stomach (ab), 831

Mayneord contour projector, applications of, to various dosage problems in radiotherapy (ab), 642
Meconium ileus; new roentgen sign (ab), 833
peritonitis, 555
Mediastinal effusion, thymus, or atelectasis? (ab), 206
tumors and cysts (ab), 1019
Mediastinum, electrokymography in pathologic densities of, and in proximity hilus (ab), 1185
lymphangioma of (ab), 626
migration of fracture-transfixing pin from humerus into, 1061
Megaphen, effect of, on survival time of roentgen irradiated rats (ab), 656

MELIOIDOSIS, chronic, roentgen findings in case of, 94
MENINGIOMAS, intracranial, evaluation of routine skull films in (ab), 829
MENISCUS injuries of temporomandibular joint (ab), 1183
METABOLISM, methodical problem in studies of, with P^{32} after irradiation of animal tumors with roentgen rays (ab), 1036
METAPHYSEAL DYSOSTOSIS, hereditary, 569
METASTASIS of bronchogenic carcinoma to bone, occurrence of; report of case with osteoblastic metastasis, 81
MIDDLE LOBE SYNDROME, etiology and radiation therapy of (ab), 1019
MIOKON, new intravenous urographic medium (ab), 838
MITRAL STENOSIS, angiocardiographic observations of intracardiac flow in the normal and in (ab), 638
congenital; roentgen study of its manifestations, 743
pathologic aspects of, 740
MOLE and chorionepithelioma, value of pelvic arteriography in diagnosis of (ab), 631
MONITORING, photographic, of stray x-rays, experiments in; characteristics of stray radiations, and choice of film-calibrating radiations in diagnostic radiology (ab), 653
photographic, of stray x-rays, experiments in; choice of film-calibrating radiations in roentgen therapy at 220 kvp. and 1,000 kvp. (ab), 653
MYCOSIS FUNGOIDES, time-dose studies in irradiation of; iso-effect curve and tumor lethal dose (ab), 642
MYELOGRAPHIC APPEARANCE of sacral cysts (ab), 632
MYELOGRAPHY, importance of, in spinal pathology, 273
of complete spinal obstruction, 248
pantopaque, measurement of cervical spinal cord in, 270
MYELOMA, solitary, of bone, 972
MYOEPITHELIAL CELLS (myoepithelioma), cutaneous tumors of sweat glands with proliferation of (ab), 651
MYELOMATOUS AREAS, roentgenologically demonstrated, of skeleton proving to be due to metastases from epithelioma, 1146
MYXEDEMA, childhood, skull in; its roentgen appearance, 495

NAVICULO-CAPITATE FRACTURE SYNDROME (ab), 1191
NECROSIS, renal papillary (ab), 839
NEOPLASMS, thymic (ab), 206
NEPHROGRAMS following intravenous urography; polycystic disease of kidney in infants, 153
NEPHROGRAPHY during routine excretory urography (ab), 1024
NERVOUS SYSTEM, central, pinealoma with metastases in; rationale of treatment (ab), 1195
NEURALGIA, trigeminal, roentgenographic findings in, 346
NEUROHYPOPHYSIS, granular cell tumor of, 324
NEUROLOGICAL SURGERY, roentgenology in relation to (E), 394
so to speak, out of roentgenology, 217
NEUTRON capturing isotope lithium^6, possible use of, in radiation therapy of brain tumors, 376
NEUTRONS, energy deposition in tissue by, of various energies and the B^{10} (n, α) Li reaction, 372
NUCLEAR detonations, criteria for evaluating gamma radiation exposures from fallout following (ab), 656
NUCLEOGRAPHY (diskography), roentgen diagnosis of herniated disk with particular reference to, 290
NUTRITIVE failure, skeletal maturation rate and radiopaque transverse lines in distal end of radius, observations on association between, in children, 482

OAK RIDGE INSTITUTE OF NUCLEAR STUDIES announces new courses, 611
announces radioisotope-measurement course, 191
OAK RIDGE NATIONAL LABORATORY, revised technique for film dosimetry at (ab), 654
OBSTRUCTION, prenatal, of fourth ventricle, 499
OCULAR calcification and retrolental fibroplasia, 583
ODELCA-CAMERA, experiences with; cerebral simultaneous serial angiography on 70×70 mm. frame (ab), 1182
ODELCA mirror camera of medium size, angiographic examinations with; indirect roentgen cinematography of cerebral vessels (ab), 637
roentgen camera, application of, for angiocardiographies and vasographies (ab), 637
ODONTOID process, agenesis of (ab), 1191
OPHTHALMOLOGY, construction and measurement of beta-ray applicators for use in (ab), 644
some applications of radioactive isotopes in (ab), 644
tantalum 182 wire gamma-ray applicators for use in (ab), 644
OS SUSTENTACULI, 1114
OSSEOUS changes in sella turcica, improvement of, following irradiation for pituitary tumor (ab), 1032
OSSIFICATION centers of vertebral bodies, significant variant in, 469
centers, secondary, and intra-articular ossicle, 1095
of multangular bones (ab), 430
OSTEITIS CONDENSANS ilii, 1141
OSTEITIS PUBIS, non-suppurative in female (ab), 1189
pathogenesis of (ab), 432
OSTEOARTHRITIS, arthritis in elderly patient (ab), 431
OSTEOCHONDRITIS ISCHIOPUBICA (ab), 1026
OSTEOCHONDRODYSTROPHY of growth (ab), 842

Osteoid osteoma, 1041
Osteolysis, massive (acute spontaneous absorption of bone, phantom bone, disappearing bone) (ab), 635
Osteomatosis, multiple polyposis of colon and soft-tissue tumors; report of familial syndrome (ab), 628
Osteomyelitis, metastatic vertebral, following prostatic surgery (ab), 1190
of vertebrae as result of infection of urinary tract (ab), 429
variolosa, 1149
Osteopathia condensans disseminata (ab), 842
Osteopetrosis, benign, 1119
Osteophytosis, asymmetry of, in thoracic spine, 1157
Osteosclerosis in renal failure (ab), 632
Ostium secundum, atrial septal defect, roentgen aspects of (ab), 204
Ovary, dermoid cysts of; roentgen features (ab), 837
Oxygen, effect of, on radiosensitivity of mammalian cells (ab), 651

P^{32}, methodical problem in studies of metabolism with, after irradiation of animal tumors with roentgen rays (ab), 1036
Pancreatic and biliary ducts, radiographic and other studies of (ab), 428
Pancreatitis, cholangiographic diagnosis of, 32
Pantomography, clinical, of jaws (ab), 1018
Pantopaque myelography, measurement of cervical spinal cord in, 270
Papilla of Vater, roentgen aspects of (ab), 832
Papillomatosis of urinary bladder, production and possible use of colloidal $As_2{}^{76}S_3$ in treatment of (ab), 645
Paramediastinal shadow of thymus (ab), 205
reply to remarks of Lasar Dünner on subject of; Hyperplasia of thymus or atelectasis of right upper lobe? (ab), 205
Paraspinal line, evaluation of, in roentgen examination of thorax (ab), 624
Patella, gout as cause of isolated circumscribed cyst of (ab), 635
Pectoral muscle, congenital absence of, 599
Pd^{109} and Y^{90} spheres, calibrated, stereotaxic implantation of; technique for producing predictable subcortical lesions in brains of laboratory animals (ab), 1034
Pediatric roentgenology, first sixty years of, in United States—1896 to 1956, 437
Pediatrics, present status of radioisotopes in (ab), 646
Pelvic arteriography, value of, in diagnosis of mole and chorionepithelioma (ab), 631
irradiation, management of some late complications of (ab), 436
metastases and involvement of parametria from carcinoma of uterus (ab), 1023
Percutaneous catheterization of renal artery (ab), 638
Periarteritis nodosa and Wegener's granulomatosis, circumscribed pulmonary lesions in, 88
Periosteal chondroma (ab), 636
Peritoneography, use of water-soluble viscous iodinated contrast media in (ab), 1023
Pharmacoradiography of stomach (ab), 1186
Pheochromocytoma, danger of aortography in localization of (ab), 1193
Phlebography, deep cerebral, diagnostic importance of normal variants in; with special emphasis on true and false "venous angles of brain" and evaluation of venous angle measurements (ab), 1182
Phosphorus 32, uptake of, by knee joint and tibia of six-week-old mice and effect of x-rays upon it; variation of uptake with time after dose of 2000 r of 200 kV x-rays (ab), 648
Photofluorography (medium size) for cerebral angiography (ab), 201
Photographic recorder, high-contrast, for scintillation counter scanning (ab), 1035
Physiology and radiology, benefits to mankind through integration of, 1037
Pinealoma with metastases in central nervous system; rationale of treatment (ab), 1195
Pinning of medial clavicular fracture, unusual sequela following, 1066
Pituitary fossa, measuring, from radiographs (ab), 635
tumor, improvement of osseous changes in sella turcica following irradiation for (ab), 1032
Placenta previa, roentgenologic diagnosis of (ab), 836
Plantar warts, roentgen therapy of, 977
Plasmacytoma, extramedullary (ab), 640
Pleural effusion, infrapulmonary (ab), 830
localized (ab), 830
Pneumatosis cystoides intestinalis (ab), 426
Pneumaturia, diabetic (ab), 839
Pneumonia, chickenpox, roentgen findings in, 533
chronic, surgical problems in (ab), 204
lipoid (mineral oil), and cor pulmonale due to cardiospasm, 108
primary chickenpox, 527
Pneumonitis, varicella (ab), 829
Pneumotomography, orbital (ab), 622
Polycystic disease of kidney in infants; nephrograms following intravenous urography, 153
Polyposis, multiple, of colon, osteomatosis and soft-tissue tumors; report of familial syndrome (ab), 628
Portal venography performed by intrasplenic injection of contrast material (splenography), evaluation of (ab), 433
venous system; its pathological roentgen anatomy (ab), 639

Postcholecystectomy dyskinesia; with pancreatitis, sphincteritis, and choledocholithiasis as causes (ab), 427
Posture in monkey, changes in length and position of segments of spinal cord with changes in (ab), 633
Pregnancy, quintuple, 70
Pregnant patient, normal, cardio-thoracic ratio in roentgenography of, 64
Pro-banthine and baridol, use of, in visualization of mucosal pattern of small intestine (ab), 833
Prolapse of pyloric mucosa, pharmaco-roentgenologic observations of (ab), 832
Prostate, present status of treatment of carcinoma of, with radioactive materials (ab), 1033
Prostatic surgery, metastatic vertebral osteomyelitis following (ab), 1190
Protection design, cobalt 60 (ab), 209
measures in university (ab), 213
radiation, in atomic energy industry (ab), 213
Protrusio acetabuli in rheumatoid arthritis (ab), 432
Psittacosis, occurrence of, in border-land (ab), 202
Pubic symphysis, gas or vacuum phenomenon in, during pregnancy (ab), 836
Pulmonary cryptococcosis (ab), 624
hemorrhage, recurrent, with hemosiderosis; so-called idiopathic pulmonary hemosiderosis, 98
hypertension in congenital heart disease, roentgen manifestations of (ab), 831
infiltrations, minimal, recognition of (ab), 623
intracavitary fungus ball (ab), 203
lesions, circumscribed, in periarteritis nodosa and Wegener's granulomatosis, 88
malignancy, metastatic, treatment of (ab), 642
vessels, roentgen appearance of aneurysmal and ectatic dilatations of (ab), 625
Pyelography and cholecystography, combined intravenous (ab), 1187
intravenous, assessment of sodium acetrizoate and experimental basis for its use in (ab), 631
Pyloric mucosa, prolapse of, pharmaco-roentgenologic observations of (ab), 832
Pyridoxine and dramamine, study of effectiveness of, on clinical radiation sickness (ab), 643

Radiation and radiomimetic drugs, treatment of lung cancer with (ab), 1029
beta, effects of, on eye (ab), 641
carcinoma of posterior tongue treated with (ab), 1028
cobalt 60 gamma, and roentgen rays with half-value layers from 1 mm. Al to 5 mm. Cu, absorption in different tissues of (ab), 649
dose distribution in water for 22.5-mev.-peak roentgen rays (ab), 643
exposures, gamma, from fallout following nuclear detonations, criteria for evaluating (ab), 656
hazard evaluation and control in hospitals (ab), 213
hazards to nonradiologists participating in x-ray examinations (ab), 212
legislative control of (ab), 655
protection during angiography, portable shield for (ab), 1026
protection in atomic energy industry (ab), 213
residual, in civil defense (ab), 656
sickness, clinical, study of effectiveness of pyridoxine and dramamine on (ab), 643
sources, cobalt 60, current techniques in handling and distribution of (ab), 1036
study section established, 611
Radiations, film-calibrating, choice of, in roentgen therapy at 220 kvp. and 1,000 kvp.; experiments in photographic monitoring of stray x-rays (ab), 653
stray, characteristics of, and choice of film-calibrating radiations in diagnostic radiology; experiments in photographic monitoring of stray x-rays (ab), 653
Radiation therapy and etiology of middle lobe syndrome (ab), 1019
in management of glioma of optic nerves and chiasm, value of (ab), 848
of brain tumors, possible use of neutron capturing isotope lithium^{6} in, 376
with fast electrons, grid method in (ab), 1030
Radiculitis, lumbar and sacral compression (herniated lumbar disk syndrome) (ab), 632
Radioactive cobalt, use of, in nylon sutures in treatment of bladder tumors (ab), 436
gold colloid, silver-coated, lymphatic drainage of, following intrathoracic administration to pneumonectomized dogs (ab), 209
gold, colloidal, treatment of chronic myeloid leukemia with (ab), 647
gold for intracavitary treatment of carcinoma of cervix (ab), 211
gold in malignant effusions (ab), 1035
gold in subarachnoid space of dog, 367
gold, mediastinal lymph node irradiation with (ab), 1033
iodine or surgery in treatment of hyperthyroidism (ab), 210
isotope I^{132}, new, contribution to clinical use of; reproducibility of short-timed radioiodine examinations (ab), 211
isotopes, some applications of, in ophthalmology (ab), 644
materials, late effects (twenty-five to forty years) of early medical and industrial use of; their relation to more accurate establishment of maximum permissible amounts of radioactive elements in body (ab), 215; (ab), 650; (ab), 1034
materials, late follow-up studies after internal deposition of (ab), 214

materials, present status of treatment of carcinoma of prostate with (ab), 1033
phosphorus in normal breast and breast tumors, uptake of (ab), 648
Radioactivity, airborne (ab), 650
low-level, effects of, in Columbia River (ab), 654
Radiogold, controlled intratumoral and intracavitary therapy with (ab), 647
Radiograph, orthometric, for obstetrical roentgenometry (ab), 837
Radiographic and other studies of biliary and pancreatic ducts (ab), 428
units, portable isotopic, 168
Radiographs, measuring pituitary fossa from (ab), 635
Radiography, multiple simultaneous body-section (ab), 845
plain, of abdomen in pediatric practice; acute abdomen (ab), 424
Radioiodine distribution and dosage in human thyroid glands, quantitative autoradiographic study of (ab), 645
examinations, short-timed, reproducibility of; contribution to clinical use of new radioactive isotope I^{132} (ab), 211
thyroid dose from, in fallout (ab), 649
treatment of hyperthyroidism, leukemia following (ab), 645
Radioisotopes in pediatrics, present status of (ab), 646
Radiologic study of duodenal stenosis in sucklings and infants as result of adhesions and volvulus (ab), 832
of gastrointestinal tract, teaching aids for instruction in (ab), 626
Radiological help in diagnosis of abdominal emergencies; acute abdomen (ab), 423
manifestations of hyperparathyroidism (ab), 1192
Radiological Society of North America; looking backward (ab), 655
Radiology and gynecology, clinical relationship of, in treatment of cervical cancer (ab), 641
and physiology, benefits to mankind through integration of, 1037
cardiovascular, expanding scope of, 721
in acute abdominal conditions, value and limitations of; acute abdomen (ab), 422
postgraduate course offered in physics of, 191
Radiomimetic drugs and radiation, treatment of lung cancer with (ab), 1029
Radionecrosis of jaws, some aspects of problem of (ab), 209
Radiopaque material, effective method of permanently marking x-ray cassettes with (ab), 654
mediums, water-soluble, nonabsorbable, in gastrointestinal examination (ab), 422
transverse lines in distal end of radius, nutritive failure and skeletal maturation rate, observations on association between, in children, 482
Radiosensitivity of mammalian cells, effect of oxygen on (ab), 651
Radiotherapeutic results, comparative, in carcinoma of endometrium as modified by prior surgery and post-irradiation hysterosalpingo-oophorectomy (ab), 1027
Radiotherapy, applications of Mayneord contour projector to various dosage problems in (ab), 642
of bronchial cancer, results of (ab), 1196
Radiothorium (Th^{228}), role of, in radium poisoning (ab), 648
Radiothyroxine, fate of endogenous, after I^{131} therapy; serum I^{131} fractionation in metastatic carcinoma of thyroid (ab), 210
Radium, internally administered, skeletal lesions following (ab), 214
poisoning, role of radiothorium (Th^{228}) in (ab), 648
Radius, radiopaque transverse lines in distal end of, nutritive failure and skeletal maturation rate, observations on association between, in children, 482
Rectum, primary treatment of adenocarcinoma of, by high voltage roentgen rays (1,000 kv.), 919
Renal failure, osteosclerosis in (ab), 632
neoplasms, roentgen diagnosis of (ab), 1024
papillary necrosis (ab), 839
Renografin, hypaque, and urokon; comparative clinical trial of urographic media (ab), 1024
Respiratory and upper digestive tract, clinical findings in foreign bodies of (ab), 207
Retrograde aortography, demonstration by, of multiple pregnancies in dog, 813
Retrolental fibroplasia and ocular calcification, 583
Retroperitoneal and abdominal viscera, trauma to, as it concerns radiologist (ab), 434
Rhinolith, 343
Rib notching following the Blalock-Taussig operation (ab), 1185
primary tumors of (ab), 431
Roentgen anatomy, pathological; portal venous system (ab), 639
appearance of aneurysmal and ectatic dilatations of pulmonary vessels (ab), 625
appearance of skull in childhood myxedema, 495
aspects of atrial septal defect, ostium secundum (ab), 204
aspects of papilla of Vater (ab), 832
cinematography, indirect, of cerebral vessels; angiographic examinations with Odelca mirror camera of medium size (ab), 637
diagnosis of benign chondroblastoma of bone, 1132
diagnosis of fruit pits in gastrointestinal tract, 136

diagnosis of herniated disk with particular reference to diskography (nucleography), 290
diagnosis of intracranial epidermoids (so-called cholesteatomas) (ab), 829
diagnosis of renal neoplasms (ab), 1024
diagnosis of spontaneous internal biliary fistulas and gallstone ileus (ab), 630
evaluation in therapy of hypothyroid infant and child (ab), 841
examination, early, in massive bleeding of upper gastrointestinal tract (ab), 626
examination of distal loop of ileum in children (ab), 1022
examination of inferior vena cava in retroperitoneal expanding processes (ab), 1194
examination of intrathoracic tumors by means of rapid serial exposures (ab), 1020
examination of thorax, evaluation of paraspinal line in (ab), 624
findings in case of chronic melioidosis, 94
findings in certain abdominal disorders, 127
findings in chickenpox pneumonia, 533
findings in gastric leiomyomas and leiomyosarcomas (ab), 1186
findings in primary hepatoma in infants and children (ab), 1022
irradiated rats, effect of megaphen on survival time of (ab), 656
irradiation, total body, effect of cysteamine, cystamine and hypoxia on mortality and bone marrow chromosome abberations in mice after (ab), 212
manifestations of caisson disease, 74
manifestations, extraintestinal, of intestinal lipodystrophy (ab), 425
radiation, effect of single doses of, on experimentally induced gliomas, 351
-radiation, influence of, on mortality following thermal flash burns; site of tissue injury as factor determining type of invading bacteria (ab), 215
-ray attenuation in lead, aluminum, and concrete in range of 275 to 525 kilovolts (ab), 216
-ray cassettes, effective method of permanently marking, with radiopaque material (ab), 654
-ray dosimeter, scintillation crystal, 979
-ray examinations, radiation hazards to nonradiologists participating in (ab), 212
-ray film processing, advance in (ab), 1194
-ray patterns, cardiac, in rheumatic heart disease; correlation of roentgen and operative findings in 150 consecutive cases; preliminary report, 693
-rays, cinemicrographic observations and theoretical considerations on reactions of lymphocytes to (ab), 216
-rays, effect of, upon uptake of phosphorus 32 by knee joint and tibia of six-week-old mice; variation of uptake with time after dose of 2000 r of 200 kV roentgen-rays (ab), 648
rays, high voltage, (1,000 kv.), primary treatment of adenocarcinoma of rectum by, 919
rays, intrauterine fetal damage by (ab), 1031
rays, 22.5-mev.-peak, radiation dose distribution in water for (ab), 643
-rays, stray, experiments in photographic monitoring of; characteristics of stray radiations, and choice of film-calibrating radiations in diagnostic radiology (ab), 653
-rays, stray, experiments in photographic monitoring of; choice of film-calibrating radiations in roentgen therapy at 220 kvp. and 1,000 kvp. (ab), 653
rays, ultrasoft, in treatment of hemangiomas; follow-up examination of 400 cases of strawberry marks and port-wine stains (ab), 1027
rays, 4,000,000 volt, dosage data for (ab), 1029
rays with half-value layers from 1 mm. Al to 5 mm. Cu, absorption in different tissues of cobalt 60 gamma radiation and (ab), 649
therapy (E), 1002
therapy, conventional, treatment of malignant lymphoma and blood dyscrasias by, 960
therapy, history of, 859
therapy of plantar warts, 977
therapy, transvaginal, in cervical cancer, review of seventeen years' experience with, 965
visualization of gastric mucosa and agglomeration of barium sulfate (ab), 1185
ROENTGENKYMOGRAPHIC study of left atrial movements in mitral cardiopathy; systolic expansion or aorto-diastolic displacement (ab), 1021
ROENTGENOGRAM, emergency skull, role of, in head trauma, 315
posteroanterior, and roentgenoscopy, practical value of, in certain types of heart disease, 664
ROENTGENOGRAMS, bitewing, variations in efficiency of, as related to age of patients (ab), 201
device for measuring circumferences on (ab), 429
lung, "hard-ray" technique as routine for (ab), 201
of entire spine on single film (ab), 841
ROENTGENOGRAPHIC demonstration of intestinal ascariasis in children without using barium, 558
findings in Cushing's disease (ab), 1183
findings in trigeminal neuralgia, 346
investigation of human skeleton during early fetal life, 455
manifestations of congenital peripheral arteriovenous communications (ab), 1193
signs of tumors of brain, 226
study of skeletal lesions in sarcoidosis (ab), 843

Roentgenographically demonstrable splenic deposits in sickle cell anemia, 47
Roentgenography, contrast, chelation in, with special reference to lead disodium EDTA, 161
of normal pregnant patient, cardio-thoracic ratio in, 64
Roentgenologic appearance, subsequent, of gallbladder, effect of cholecystostomy upon (ab), 630
diagnosis of placenta previa (ab), 836
diagnosis, prenatal, of thoracopagus (ab), 631
evidence of calcification in peripheral bronchogenic carcinoma (ab), 1184
findings of small intestine in 100 repatriated prisoners of war; deficiency states and worm infestations, 149
findings, some normal, ischiopubic synchondrosis in healthy children, 488
investigation of patients with heterosexual development, 562
measurements, estimation of skull capacity from, 303
Roentgenologically demonstrated myelomatous areas of skeleton proving to be due to metastases from epithelioma, 1146
Roentgenology, cardiovascular, sixty years of, 657
geriatric, of normal and its borderlines, 115
in relation to neurological surgery (E), 394
neurological surgery, so to speak, out of, 217
pediatric, first sixty years of, in United States—1896 to 1956, 437
Roentgenometry, obstetrical, orthometric radiography for (ab), 837
Roentgenoscopy and the posteroanterior roentgenogram, practical value of, in certain types of heart disease, 664
Rokitansky-Aschoff sinuses, cholecystographic visualization of; report of case and review of literature (ab), 835
Rotational subluxation, examination of atlantoaxial joint following, with particular emphasis on, 1081

Sacral cysts, myelographic appearance of (ab), 632
Saint's triad (hiatus hernia, cholelithiasis and diverticulosis of colon) (ab), 628
Salivary glands, iodine-concentrating and iodine-secreting capacity of (investigated with I^{131} in patients with varied thyroid function) (ab), 646
mixed tumors (pleomorphic adenomas) of (ab), 652
Sarcoidosis of alimentary tract (ab), 426
roentgenographic study of skeletal lesions in (ab), 843
Sarcoma, fibrous dysplasia of skull with, 320
Sarcomatosis, sclerosing osteogenic; radiologic entity (ab), 431
Scintillation counter scanning, high-contrast photographic recorder for (ab), 1035
Secretory disease of breast, calcification in, 132
Sella turcica, improvement of osseous changes in, following irradiation for pituitary tumor (ab), 1032
Septal defect, atrial and valvular pulmonary stenosis, changes in; electrokymographic studies of normal and abnormal right auricles (ab), 625
Sialography (ab), 622
Sickle cell anemia, roentgenographically demonstrable splenic deposits in, 47
crises, relationship of cholelithiasis to (ab), 836
Sinus of Valsalva, aneurysms of, 767
Skeletal lesions following internally administered radium (ab), 214
lesions in sarcoidosis, roentgenographic study of (ab), 843
lesions, multiple, in young children due to trauma (ab), 1190
maturation rate, nutritive failure and radiopaque transverse lines in distal end of radius, observations on association between, in children, 482
Skeleton, human, roentgenographic investigation of, during early fetal life, 455
roentgenologically demonstrated myelomatous areas of, proving to be due to metastases from epithelioma, 1146
Skull capacity, estimation of, from roentgenologic measurements, 303
fibrous dysplasia of, with sarcoma, 320
films, routine, in intracranial meningiomas, evaluation of (ab), 829
in childhood myxedema; its roentgen appearance, 495
primary epidermoids of, including case with malignant change, 1076
roentgenogram, emergency, role of, in head trauma, 315
Smith-Petersen nail, large foreign body cyst with migration of, 1070
Sodium acetrizoate, assessment of, and experimental basis for its use in intravenous pyelography (ab), 631
(diaginol) 50 per cent and sodium diatrizoate (hypaque) 45 per cent, comparative study of value of, in intravenous urography (ab), 1190
Spinal canal, width of, in growing vertebra with special reference to sacrum; maximum interpediculate distances in adults and children, 476
cord, cervical, measurement of, in pantopaque myelography, 270
cord, changes in length and position of segments of, with changes in posture in monkey (ab), 633

cord, involvement of, by intervertebral disk protrusions (ab), 840
cord lesions produced by aortography in dogs (ab), 433
obstruction, complete, myelography of, 248
pathology, importance of myelography in, 273
Spine, cervical, Luschka joints of (ab), 634
entire, roentgenograms of, on single film (ab), 841
thoracic, asymmetry of osteophytosis in, 1157
Spinning lead top, use of, in locating and evaluating technical breakdowns (ab), 654
Splenography; evaluation of portal venography performed by intrasplenic injection of contrast material (ab), 433
Splenoportography in diagnosis of hydatid cysts of liver (ab), 1027
Spot-film examination, upright fluoroscopic, of gallbladder, experiences with (ab), 1187
Stenosis, hypertrophic pyloric, dehydration and deficiency of intestinal gas in infants with, 551
valvular pulmonary, and atrial septal defect, changes in; electrokymographic studies of normal and abnormal right auricles (ab), 625
Stereoencephalotomy, studies in; roentgenologic localization of lesions or implanted electrodes, 311
Stereotaxic implantation of calibrated Pd^{109} and Y^{90} spheres; technique for producing predictable subcortical lesions in brains of laboratory animals (ab), 1034
Sternum, normal, technique and radiographic anatomy of (ab), 1192
Stomach, benign inflammatory fibroid polyps of; granuloma with eosinophils (ab), 627
congenital and acquired syphilis of; with special reference to gastric deformity in various stages, and report of two cases (ab), 422
lymphosarcoma of (ab), 831
pharmacoradiography of (ab), 1186
Subarachnoid space of dog, radioactive gold in, 367
Subdural collections of fluid in infants and children; visualization of capsule with thorium dioxide, 507
Subepiphyseal linear translucencies of early infancy with special consideration of osteomyelitis (ab), 1191
Supracondyloid process of humerus, clinical significance of, 1154
Supervoltages and large masses of radio-elements in treatment of cancer in general, use of (ab), 847
Surgery, cardiovascular, accomplishments and possibilities in, 730
Sweat glands with proliferation of myoepithelial cells (myoepithelioma), cutaneous tumors of (ab), 651
Synchondrosis, ischiopubic, in healthy children; some normal roentgenologic findings, 488
Syndrome, middle lobe, etiology and radiation therapy of (ab), 1019
naviculo-capitate fracture (ab), 1191
Turner, male (ab), 1191
Syphilis, congenital and acquired, of stomach; with special reference to gastric deformity in various stages, and report of two cases (ab), 422
Systolic expansion or aorto-diastolic displacement; roentgenkymographic study of left atrial movements in mitral cardiopathy (ab), 1021

Tantalum 182 wire gamma-ray applicators for use in ophthalmology (ab), 644
Technical breakdowns, use of spinning lead top in locating and evaluating (ab), 654
Telecurie therapy, cobalt-60, some observations on clinical effects of, 895
Telepaque cholecystography, re-evaluation of fat-free preparatory meal in, 21
Teletherapy units, medium distance, physical requirements of beam defining systems for (ab), 650
Temporomandibular joint, meniscus injuries of (ab), 1183
Tendinitis, supraspinatus, excavation of humeral head by calcareous deposits of (ab), 634
Therapy, bismuth-206, pure gamma-emitter for (ab), 1034
controlled intratumoral and intracavitary, with radiogold (ab), 647
rotation, with 2 mev. Van de Graaff generator (ab), 1029
Thoracic discs, ruptured (ab), 433
duct, importance of, in spread of malignant disease (ab), 1021
ductography, operative (ab), 207
esophagus, squamous cell carcinoma of, 949
Thoracopagus, prenatal, roentgenologic diagnosis of (ab), 631
Thorax, evaluation of paraspinal line in roentgen examination of (ab), 624
Thorium dioxide, visualization of capsule with; subdural collections of fluid in infants and children, 507
Thrombotic state, temporary; application of concept to therapy of recurrent thromboembolism with bacteriologic and roentgenologic considerations in differential diagnosis of pulmonary infarction and pneumonia (ab), 624
Thymus, atelectasis, or mediastinal effusion? (ab), 206
hyperplasia of, or atelectasis of right upper lobe? Reply to remarks of Lasar Dünner on subject of paramediastinal shadow (ab), 205

paramediastinal shadow of (ab), 205
Thyroid, cancer of, and irradiation (ab), 1196
carcinoma, metastatic, evaluation of various factors influencing treatment of, with I^{131} (ab), 646
dose from radioiodine in fallout (ab), 649
function, varied, iodine-concentrating and iodine-secreting capacity of salivary glands investigated with I^{131} in patients with (ab), 646
gland, cancer of (ab), 1195
glands, human, quantitative autoradiographic study of radioiodine distribution and dosage in (ab), 645
serum I^{131} fractionation in metastatic carcinoma of; fate of endogenous radiothyroxine after I^{131} therapy (ab), 210
Tibia and knee joint of six-week-old mice, uptake of phosphorus 32 by, and effect of x-rays upon it; variation of uptake with time after dose of 2000 r of 200 kV x-rays (ab), 648
Tissue injury, site of, as factor determining type of invading bacteria; influence of x-radiation on mortality following thermal flash burns (ab), 215
Tongue, posterior, carcinoma of, treated with radiation (ab), 1028
Trachea, carcinoma of (ab), 435
Translucencies, subepiphyseal linear, of early infancy with special consideration of osteomyelitis (ab), 1191
Tube, 0.3-mm. focal spot, for magnification and other technics, advantages and limitations of (ab), 845
Tuberculin and histoplasmin, incidence of splenic calcifications in positive reactors to, 53
Tumor, granular cell, of neurohypophysis, 324
lethal dose and iso-effect curve; time-dose studies in irradiation of mycosis fungoides (ab), 642
Tumors, bladder, use of radioactive cobalt in nylon sutures in treatment of (ab), 436
bone, benign conditions simulating (ab), 430
brain, possible use of neutron capturing isotope $lithium^6$ in radiation therapy of, 376
cutaneous, of sweat glands with proliferation of myoepithelial cells (myoepithelioma) (ab), 651
glomus jugulare; clinical and radiological features (ab), 633
human, observations on growth rates of, 988
intrathoracic, roentgen examination of, by means of rapid serial exposures (ab), 1020
malignant, of eyelids (ab), 434
mediastinal, and cysts (ab), 1019
mixed (pleomorphic adenomas) of salivary glands (ab), 652
of brain, roentgenographic signs of, 226
of carilaginous series (ab), 430
of lymphoid tissue, some basic concepts regarding, 956
primary, of rib (ab), 431
soft-tissue, multiple polyposis of colon and osteomatosis; report of familial syndrome (ab), 628
Turner syndrome, male (ab), 1191
Tympanic cavity and auditory ossicles, 327

University of Minnesota offers radiation therapy course, 819
Ureteral reflux in normal infants (ab), 429
Urethrography, positive pressure: new diagnostic method (ab), 1025
Urinary bladder, production and possible use of colloidal $As_2{}^{76}S_3$ in treatment of papillomatosis of (ab), 645
incontinence in men, some studies of (ab), 840
tract obstructions, congenital, in children (ab), 838
tract, osteomyelitis of vertebrae as result of infection of (ab), 429
Urine test, $cobalt^{60}$-labeled vitamin B_{12}, clinical application of (ab), 210
Urographic media, comparative clinical trial of; renografin, hypaque, and urokon (ab,) 1024
medium, new intravenous, miokon (ab), 838
mediums, intravenously given; comparative study of eight hundred cases (ab), 1189
Urography, intravenous, accidents during (ab), 838
intravenous, nephrograms following; polycystic disease of kidney in infants, 153
routine excretory, nephrography during (ab), 1024
Urokon, renografin, and hypaque; comparative clinical trial of urographic media (ab), 1024
Uterine enlargement, unusual, caused by bleeding due to hypofibrinogenemia associated with fetal death (ab), 837
Uterus, pelvic metastases and involvement of parametria from carcinoma of (ab), 1023

Van de Graaff machine, 2 mev., notes on isodose curves from, 929
Varicella pneumonitis (ab), 829
Vasographies and angiocardiographies, application of Odelca roentgen camera for (ab), 637
Vena cava, inferior, roentgen examination of, in retroperitoneal expanding processes (ab), 1194
Venography, abdominal, in urological diagnosis (ab), 844
abdominal; technique of roentgen visualization of inferior vena cava, 807
portal, performed by intrasplenic injection of contrast material (splenography), evaluation of (ab), 433
Venous angle measurements, special emphasis on true and false "venous angles of brain"

and evaluation of; diagnostic importance of normal variants in deep cerebral phlebography (ab), 1182
VENTRICLE, fourth, prenatal obstruction of, 499
VERTEBRAE, osteomyelitis of, as result of infection of urinary tract (ab), 429
VERTEBRAL bodies, significant variant in ossification centers of, 469
column, intertransverse processes of (ab), 634
VOMITING in infancy and childhood, some rare causes of (ab), 1021
WATER-SOLUBLE, nonabsorbable radiopaque mediums in gastrointestinal examination (ab), 422
viscous iodinated contrast media, use of, in peritoneography (ab), 1023
WILMS' TUMOR, treatment of (ab), 1029

Y^{90} and Pd^{109} spheres, calibrated, stereotaxic implantation of: technique for producing predictable subcortical lesions in brains of laboratory animals (ab), 1034

AUTHOR INDEX TO VOLUME 76

*=Original Article

Aaron, Jules B., 836
Abbatt, John D., 645
Abel, Martin S., 845
Acheson, Roy M., 635
Adams, David B., 1186
Adams, Elizabeth K., 1187
Adams, Erie D., 836
Adelman, Bernard P., 622
Adler, Denis C., *1081
Adler, Howard, 1032
Aldridge, N. H., 1187
Alexander, Eben, Jr., 1195
Alexander, M. K., 632
Alexander, Peter, 193
Allen, David H., *576
Allen, E. H., 426
Allen, Edgar V., 823
Allen, Marshall B., 1033
Alley, Ralph D., 207
Amdrup, E., 1027
Amundsen, Per, 1019
Anderson, Vivian E., 210
Angei, A., 1027
Anguenot, G., 832
Araj, Jacob S., *1119
Arcomano, Joseph, 427
Arneson, A. N., 641
Auerbach, S. H., 209
Aurig, G., 1026
Avin, Joseph, 1191
Azad, Manouchehr, 202

Babyn, Roman, *1070
Backmann, R., 1036
Bacq, Z. M., 193
Bahnson, Henry T., *730
Baily, Norman A., 848
Bain, G. O., 652
Baker, Charles P., 626
Bakwin, Harry, 1190
Balcázar Morrison, A. J., 422
Balzarini, Emilio, 1192
Barger, James D., *758
Barker, Nelson W., 823
Barrett, N. R., 431
Barry, William F., Jr., 830
Basić, Marko, 1031
Bass, Murray H., 431
Bassöe, Hans H., *1146
Batten, J. C., 426
Bauer, Franz, 210
Beck, R. E., *320
Becker, J., 1030
Bell, A. L. L., 427
Beller, Aaron J., 1182
Bellini, M. Arias, *495
Benach, Bienvenido, 631
Beneventi, Francis A., 840
Bennet, J., 832
Berardinelli, Stephen D., *599
Berenberg, Arnold L., 834
Berg, Harold F., 212, 1032
Berger, I. R., *773
Berger, S. M., *39
Berman, Robert, 192
Berman, Shimon, 1182
Bertcher, Robert W., *1149
Bewley, D. K., 214
Beyer, Norman S., 848
Bhattacharya, K. L., 648
Biempica, L., 422
Birsner, J. W., *1052
Birzle, H., 1184
Black, Harrison, 1033
Blank, Leo, *540, 627
Bligh, A. S., 630
Blount, S. Gilbert, Jr., 204
Bohne, A. W., 1024
Bolen, John G., 1193
Bonmati, José, 624
Bonte, Frederick J., *64, 433
Boreadis, A. G., 634
Borell, Ulf, 631
Borrelli, F. J., *273
Bose, A., 648
Boyd, George A., 1013
Boyd, William, 194
Boyesen, Svein, 1034
Braestrup, C. B., 209
Brandborg, Lloyd, 210
Bregman, Edward H., *758
Breuer, A., 202
Brocher, J. E. W., 413
Brookfield, R. W., 632
Brooks, James W., 215
Brooksaler, Fred, 1025
Brown, B. H., *972
Browne, Frank S., *576
Bruwer, André J., *98, *664
Buchheim, C. E., 201
Buchmann, Erich, 1031
Bugden, Walter F., 208
Bulkley, George J., 1033
Bunim, Joseph J., 431
Bürger, M., 192
Burke, Donald E., *807, 844
Burkell, C. C., *895
Burman, Michael, *1061
Burnett, Harry W., Jr., *949
Bushe, K. A., 1182
Bushman, M., 213
Caffey, John, *437, *448, 612
Camiel, Mortimer R., 836
Campbell, James B., 1034
Campbell, James H., 837
Canepa, Giuseppe, 842
Cantril, Simeon T., 435
Carlson, R. I., 209
Carnevali, G., 1023
Carter, John R., *956
Castro, Victoria, 642, 655
Caulk, Ralph M., *965
Cayler, Glen G., 841
Celis, Alejandro, 1021
Chalek, C. C., 1024
Chamberlain, Richard H., 1035
Chamberlain, W. Edward, 177, *1037
Charache, Herman, *594
Childress, Max E., 626
Christie, Arthur C., *1
Christman, Robert O., *1144
Christopherson, William M., 212, 1032
Church, Gaylord, 836
Cian, Louis G., 1025
Cicero, Raúl, 202
Cimmino, Chrostian V., 1187
Clagett, O. Theron, 842
Clark, Dwight E., 210
Close, Myron B., 1190
Cohen, Beverly S., 655
Cohen, Jonathan, *469
Cohen, Sidney, 624
Colcher, A. Edward, *693
Coley, Bradley L., 1026
Collins, Lois C., 430
Collins, Vincent P., 430, *988
Colodzin, Martin, 214
Comas, Mario Delgado, 208
Comas Mutierrez, Gaston, 435
Conger, Alan D., 651
Conklin, Frances P., 425
Cooley, Robert N., *743
Cooper, John A. D., 1033
Cooper, Philip, 628
Corbett, B. D., 645
Corney, G. M., 653
Corrigan, Kenneth E., 1015
Corsentino, B., *351
Costa, V., 1023
Coventry, Mark B., 429
Craig, John M., *516
Craver, Lloyd F., *849
Crosby, R. M. N., *507
Croxatto, O., 422
Cruz, Miguel, 1026

Culver, Gordon J., *1157
Curran, Harold P., 630
Currarino, Guido, *469
Currie, Catherine, *482
Cusmano, Joseph V., 837

Dahlin, David C., 635, 842
Dalith, F., 1021
Dalton, Catherine J., 624
D'Angio, Giulio J., 212
Das Gupta, N. N., 648
Davidoff, Leo M., 417
Davies, T. V., *303
Davis, Courtland H., Jr., 1195
Davis, Hugh James, 1025
Davis, James G., *343, 634, 1186
Davis, L. A., 1185
Davis, Loyal, *217
De, P. K., 648
Deeley, T. J., 1030
del Castillo, Ermilo, 1021
Del Castillo, Hermilo, 202
Delmonico, J. Ernest, Jr., 208
DeMuth, William E., Jr., *555
Dennis, John M., *507
de Sèze, Stanislas, 193
Deutschberger, Otto, 616
Devik, Finn, 212
Dewar, James P., 640
De Wilde, Herman, 201
Dijkstra, C., 616
Dockerty, Malcolm B., *1041
Doehner, Gunther A., 639
Doke, Tadayoshi, 650
Dolin, Simon, 640
Donnelly, R. W., *942
Dorosin, Norman, 634
Dotter, Charles T., 817
Doub, Howard P., 425
Dreizen, Samuel, *482
Drew, D. R., 1024
Dubilier, William, Jr., 622
Duncan, J. G., 1192
Dünner, L., 205
Dünner, Lasar, 615
Dunning, Gordon M., 649, 656
Dunning, James M., 201
Durant, Thomas M., 845
Dutt Choudhuri, R., 648

Eberlein, Walter R., *562
Ecker, Arthur, 416
Edholm, Paul, 638
Edinger, A., 841
Edwards, Jesse E., *98, *740, *748
Effler, Donald B., 206
Eliasoph, Joan, 214
Elkins, H. B., *960
Ellis, Kent, 643
Endress, Z. F., 829
Enselberg, Charles D., 1193
Epstein, Bernard S., 417
Erhard, Gerald A., *1119
Ernst, W. S., 643
Esser, C., 206
Etter, Lewis E., 413
Evans, Everett Idris, 215
Evans, John A., 622, 839
Evans, Titus C., 213
Eyler, W. R., 1024
Eyler, William R., 425

Fahey, John J., *1102
Failla, G., 652
Fariñas, Laura, 631
Fariñas, Pedro L., 631
Farran, Helen E. A., 645
Farrior, J. Brown, 413
Feinberg, S. B., 636
Feinberg, Samuel B., *551
Feld, Harold, *81
Fellinger, K., 211, 647
Felson, Benjamin, 204
Fenton, Richard L., 1191
Ferlazzo, G., 213
Fernandez, Orlando Lopez, 208
Fernstrom, Ingmar, 631
Fertig, John W., 643
Fetter, Theodore R., 838
Fiegel, Leo S., *24
Figiel, Steven J., *24
Figley, Melvin M., *721
Finby, Nathaniel, *108, 1192
Fincher, Edgar F., 829
Fischer, Harry W., *143
Fischer, Robert M., *599
Fisher, W. C., *320
Fissel, George E., *60
Fitting, W., 646
Fitz, Fred W., 626
Flaherty, Robert A., *1041
Fleischner, Felix G., 624, 834
Fletcher, Gilbert H., *866
Foord, R. D., 839
Ford, Mary M., *512
Fournet, Gérard, 1011
Fowler, Fred D., 1195
Francke, Walter, *149
Frangella, Alfonso C., 1012
Frantz, Charles H., 1189
Freemond, Alan, 622
Freid, J. R., *351
Freundlich, Emil, 1182
Friedman, Milton, 642
Frimann-Dahl, J., 422
Frink, W., 201
Fulton, Harold, *657
Furlow, Leonard T., 632

Gaca, A., 1182
Gaebel, E., 834
Gaines, L. M., Jr., 835
Gajewski, H., 841
Gandini, D., 1022
Gandini, Dario, 616
Gannon, William E., 847
Garciga, C. E., 434
Gardner, W. James, *346
Garland, L. H., 1196
Gensini, Goffredo, 204
Gepp, H., 841
Gerbaulet, K., 646
Gershon-Cohen, J., *132, 634
Ghislanzoni, R., 640
Ghormley, Ralph K., 635
Gilbertson, Eva L., *226
Gilfillan, Rutherford S., 432
Gilles, Evelyn, 413
Gilley, Ellie Jo, *482
Gimes, B., 832
Glauser, Frank, *1066
Glazenbrook, A. J., 833, 835
Glazer, Norman, *324
Goetz, R. H., 654
Goff, Charles Weer, 613
Goldberg, Gil M., 1193
Goldman, Alfred, 203
Gómez Zaldívar, Rafael A., 631
Good, C. Allen, *226, 1184
Goodwin, Willard E., 844
Gorham, L. Whittington, 635
Gorson, Robert O., 1035
Gould, David M., 622
Green, B., 1190
Greene, D., 1029
Greenfield, Henry, 847
Greenfield, M. A., *372
Greenhill, J. P., 195
Gregg, E. C., *979
Grimson, Keith S., 433
Grosse-Brockhoff, 822
Grossman, Sol, *1061
Guinier, André, 1011
Gupton, Edwin D., 654

Haas, Lewis L., *905
Habbe, J. Edwin, *706
Haddow, A., 1014
Hadley, Lee A., *1095
Hahn, P. F., 209
Haig, P. V., *1076
Hajdu, Nicholas, 424
Hale, John, 1035
Hall, Maxwell F., Jr., 829
Hallerbach, H., 822
Ham, William T., 215
Harmston, Gordon J., 842
Harris, Elmer J., *767
Harris, John H., *555

Harris, John H., Jr., *555
Harriss, Eileen B., 645
Hartmann, Edward, 413
Harvey, Roger A., *905
Hastings-James, Richard, 835
Haubrich, R., 822
Hauser, Harry, *324, 396
Haybittle, J. L., 650
Hebbel, Robert, 627
Heck, Charles V., 1019
Heckmann, K., 830
Heese, R., 201
Heinrich, Ward D., *762
Helander, C. G., 1194
Helwig, Harold L., 1032
Henderson, Croswell, 654
Henderson, Samuel G., 413
Henry, George W., 623
Henson, Stanley W., Jr., 429
Hermel, M. B., *132
Hernández, Martha, 202
Heuck, F., 427
Hiemsch, W., 637
Hilbish, Theodore F., *743
Hilgert, F., 206
Hills, T. H., 1194
Hines, Edgar A., 823
Hinkel, C. L., *153
Hobbs, A. A., Jr., *320
Hodes, Philip J., *327
Hodges, Fred Jenner, 418, 825
Hoerr, Normand L., 415
Höfer, R., 211
Höffken, W., 623, 841, 1184
Hoffman, George, 639
Hoffman, Marillyn, *351
Holinger, Paul H., *942
Holm, Olov Fr., 1188
Holmes, George W., 614
Holsti, Lars R., 1026
Holt, John F., 622
Holt, John Floyd, 418, 825
Holzmann, M., 824
Hooper, R. S., 633
Hope, John W., *562
Hopkins, William A., 624
Horrax, Gilbert, 394
Horwitz, Norman H., 433
Horwitz, H., *919
Hsieh, Charles L., 1030
H:son Holmdahl, Kaj, 1188
Huang, Kee-Chang, 422
Hunt, Howard B., 1027
Hurwitt, Elliott S., *813

Iannaccone, Guido, 429
Immerman, Lewis, 427
Ingleby, Helen, *132
Isaacs, Ivan, *558
Israel, Harold L., 843

Jackson, Murray T., *977
Jacobson, A., 213
Jacobson, George, *47, *1081
Jacobson, Harold G., 432, 832, 1189, 1192
Jacobson, Lillian E., 649
Jacox, Harold W., 418
Jacqueline, F., 844
Janker, R., 822
Jaques, William E., 1033
Jefferson, K., 426
Jenkins, Ritchie T., 422
Jenkinson, Edward L., *942
Johnson, Richard P., 1190
Johnston, K. C., *942
Jonsson, Bengt, 821
Jordon, Paul H., Jr., 628
Juliani, G., 1022

Kao, Lillian, *942
Kaplan, Gustave, 1032
Katz, Isadore, *599
Kaufman, S. A., *527
Kaufman, Joseph J., *807, 844
Kausel, Harvey W., 207
Keates, P. G., 631
Keats, Theodore E., 831
Keith, John D., 639
Kelly, Charles R., 642
Kelly, Eugene W., 638
Kennedy, J. A., *303
Kennedy, R. J., 216
Kennedy, Roger L. J., *98
Kereiakes, J. G., *168
Keusters, J., 847
King, J. Cash, 434
Kirkpatrick, John, *516
Kjellberg, Sven R., 821
Klayman, Melvin I., 210
Kleeberg, J., 628
Klein, Günther, 656
Kligerman, Morton M., 418, 643
Knauer, Isabelle, 649
Knoefel, P. K., 1185
Knudsen G., 1027
Kowalewski, K. P., 652
Krabbenhoft, Kenneth L., *859
Kraemer, Willis F., 204
Kraus, Rudolf, 208
Krebs, A. T., *168
Kreis, Van Allen, 831
Kremens, Victor, *1066
Kriss, Nathan, 830, *1154
Krueger, Erich G., 1026
Kuhl, David E., 1035
Kuthy, José, 1021

Lachman, Ernest, *115
Lackner, J., 637
Lafebvre, J., 832
Lamerton, L. F., 645
Lampe, Isadore, 825
Langston, Hiram T., 642
Lanier, Raymond R., 204
Lasser, Elliott C., 846
Lawlah, John W., *70
Layne, John A., 630
Lederman, M., 644
Lee, C. Marshall, Jr., 1188
Leigh, Ted F., 829
Lenk, Robert, *569
Lentino, Walter, 630, 1189
Leupold, F., 427
Leucutia, T., 1002
Levene, George, *527
Levin, Emanuel J., 203
Levy, R. W., 1191
Lewis, Raymond W., 416
Lewison, Edward F., 1011
Lillie, A. B., 1036
Liming, Robert W., 1190
Lin, Paul M., *804, 1182
Lindbom, Å., 1194
Lindholm, S. O., 1019
Lissner, J., 1185
Lochman, David, J., 1029
Lodge, Thomas, 194
Loeffler, R. Kenneth, *988
Loevinger, Robert, 650
London, Russell I., *1114
Looney, W. B., 215, 650, 1034
Looney, William B., 214
Lootens, C. Louis, 1030
Lothe, Francis, 212
Lotzkes, H., 822
Low-Beer, Bertram V. A., 1029
Lucarelli, U., 1023
Luessenhop, Alfred J., *376
Lusted, Lee B., 841
Luttwak, Edmund M., 1193
Lyford, John, III, 635

McCallen, Albert, 844
McCormack, Lawrence J., 206
MacDonald, J. C. F., 1035
McDonald, John R., 1184
McEwen, Currier, 432
McGee, Andrew R., 426
MacGregor, J. W., 652
MacKinnon, I. L., *303
MacLennan, W. Donald, 209
Magilner, Louis, *693
Maglione, A. A., *273
Maisin, H., 847
Maisin, J., 847
Maloof, Farahe, 646
Malsky, Stanley, 1026
Mandel, William, 835
Mannheimer, E., 647
Mannheimer, Edgar, 821

March, Herman C., *1114
Marden, Philip A., *327
Margolis, George, 433
Margulis, Alexander R., 425, *551, 1022, 1193
Marilley, R. J., Jr., 835
Marshak, Richard H., *136, 214, 833
Marshall, Victor F., 840
Martin, Charles L., 1028
Martin, James A., 1028
Martin, James F., *782
Martmer, Edgar E., 606
Massenti, S., 1023
Matson, Donald D., *499
Matuska, R. A., 209
Maxfield, J. G. S., 436
Medrano, Fidel Aguirre, 208
Medrano, Olga Aguirre, 208
Mahl, H. G., 647
Melamed, Myron, 1022
Mendl, Karl, 422
Meneely, G. R., 209
Meredith, W. J., 655
Merner, Thomas Borden, 182
Merriam, George R., Jr., 641
Meyer, David B., *455
Millar, Owen, 1035
Miller, J. E., 1025
Miller, William, 216
Minder, Walter, 1010
Mintz, A. Aaron, 836
Mitchell, David J., 1188
Mokrohisky, John F., 1182
Mongeon, C., 833
Monro, Donald, 632
Mooney, R. T., 209
Moore, S. W., *949
Moore, Sherwood, 417
Morgan, Jack M., *934
Morgan, Russell H., 1014
Mori, Paul A., 622
Morris, John de L. S., *801
Morris, Roger S., 1029
Morrison, R., 1030
Moseley, John E., 431
Moulún, Mario, 202
Mount, Lester A., 848
Murphy, John J., 436
Murphy, Thomas O., 1193
Myant, N. B., 645

Nabarro, J. D. N., 839
Napoleone, F., 1027
Nesbit, Reed M., 838
Netsky, Martin G., *351
Neuhauser, Edward B. D., *469, 516
Neves, Ilda, *495
Newbery, G. R., 1030
Newburger, Robert A., 214
Newstedt, J. Roger, 1188
Ng, Elmer, 1029
Nice, Charles M., *551
Nice, Charles M., Jr., 202, 425, 1022
Nicholson, T., 213
Nicolai, Charles H., 838
Nowak, Edward L., 846

O'Connell, John E., 840
O'Conor, Vincent J., 1033
O'Conor, Vincent J., Jr., 1033
Oderr, Charles P., *94
Ödman, Per, 625, 638
Oeser, H., 647
Olivetti, Renzo G., *81
Oppenheimer, M. J., 845
O'Rahilly, Ronan, *455
Orton, K. F., 1029
Osheroff, H. R., 626
Osmond, John D., Jr., 837
Ottoman, R. E., 1024
Ovadia, J., 643

Paatero, Yrjö V., 1018
Palange, Ralph C., 654
Palmer, Eddy D., 1185
Pantone, Anton M., 1022
Panzironi, Paolo Emilio, 429
Paracchi, P., 1023
Parker, H. M., 213
Partington, Philip F., *32
Paul, Robert E., 1182
Peacher, William G., *290
Pearlman, Alexander W., 642
Pellerin, D., 832
Pendergrass, Eugene P., *327, 655
Penny, Stuart F., 426
Pesquier, Claude M., 837
Petersen, Olaf, 1185
Peterson, Carrell A., 841, 1190
Petrakis, Nicholas L., 432
Pew, Wilmer L., *540
Pfeiffer, J., 1186
Piatt, Arnold D., *1119
Piavello, Carlo, 433
Pickering, Donald E., 841
Pierce, A. W., *576
Pilla, L. A., 1185
Pinto, J. Portugal, *346
Pirkey, Everett L., 422
Pirson, Herbert S., *1157
Pochin, E. E., 645
Poker, Nathaniel, 432
Pompili, Giuseppe, 1192
Poppe, H., 1182
Poppel, Maxwell H., *74, 432, 832, 1026, 1144, 1189, 1192
Porter, Edward C., *270
Principato, Dominick J., 630
Puente Duany, N., 651
Pugh, David G., 635, 842, 1041
Pyle, S. Idell, 415

Quimby, Edith H., 642, 655

Radke, H., 1026
Ralston, Edgar L., 1031
Rapp, Betty, 646
Rausch, F., 637
Ravelli, A., 430
Rawson, S. P., 1021
Reeve, Thomas S., 207
Reeves, Robert J., *977
Reich, Leo, *127
Reid, J. Douglas, 215
Reilly, Francis G., 433
Reilly, W. A., 1032
Reilly, William A., 646
Reimer, E. E., 647
Reitter, Hans, 204
Rentzhog, Uno, 629
Rhodes, Ivan E., 212
Riblett, Victor T., *801
Richards, A. J., 831
Richards, Charles M., 180
Richardson, Jasper E., *934
Riches, E. W., 839
Riemenschneider, Paul A., 416
Rigler, Leo G., 425, 627, 1022
Ringertz, N., 1019
Ritvo, Max, 212
Robbins, Laurence L., 614, 846, 1183
Robeck, Gordon G., 654
Roberto, Albert E., *88
Roberts, Edith A., 1011
Roberts, S. M., 835
Robinson, Janette, *376
Robinson, William T., *74
Robson, J. W., *979
Rogers, James V., Jr., *88, 624, 1187
Rogoff, Stanley M., *787
Rollins, Marvin, *64
Romanini, A., 634
Roncoroni, L., 634
Rosenak, Stefan, *1061
Ross, Donald E., 1195
Ross, Steven E., *488
Ross, Wayne D., 839
Rossetti, Mario, 626
Rossi, Ettore, 613
Rossi, Harald H., 652
Rotter, Carl W., 837
Rousselot, Louis M., 639
Rowe, Richard D., 639
Royer, M., 422
Rubenfeld, Sidney, *367
Rubin, E. L., 632

Rudhe, Ulf, 821, 823
Rule, James H., 210
Rummel, A., 836
Rushmer, Robert F., 822
Russell Hughes, J., 422
Russo, P. E., *972, 1191
Ruzicka, Francis F., Jr., 639
Ryckewaert, Antoine, 193
Rytand, David A., 825

Sachs, Maurice D., *32
Sackett, George L., Jr., *512
Saltz, Nathan J., 1193
Samson, Paul C., 626
Santini, L. C., *153
Santos, Carlos, 416
Sauvegrain, J., 832
Savastano, Americo A., 1183
Schaede, A., 822
Schaff, Burnett, 844
Schajowicz, Fritz, 430
Schiefer, W., 637
Schiff, Leon, 414
Schlenker, Leo T., *1102
Schlotter, Hans, 625
Schlungbaum, W., 647
Schmid, P. Ch., 205
Schnell, F. R., 829
Schorr, S., 628
Schrek, Robert, 216
Schultz, E. H., Jr., 1191
Schulz, R. J., *939
Schulze, H.-E., 829
Schwartz, Armin, 1193
Schwartz, Solomon S., 624
Schwartzman, Joel J., *813
Schwarz, Gerhart S., 429, *476, 837
Schwarz, J., *53
Scott, Kenneth G., 1032
Seaman, William B., 632
Secrétan, Michel, 838
Seelentag, W., 654
Seghini, Giuseppe, 842
Seldinger, Sven Ivar, 638
Serviansky, B., *53
Shapiro, David, 635
Shapiro, G., 643
Shapiro, Jerome, *351
Shapiro, Robert, *161
Sharpe, J., 1012
Shaw, James F., *94
Shehadi, William H., *7
Sherman, Alfred I., 211
Sherman, Louise S., 413
Sherman, Robert S., 843, *1132
Shumacker, Harris B., Jr., 414
Siddall, H. Stewart, 1188
Silver, Caroll M., 1183
Silverman, Anna, 643
Simon, Stanley D., 1183
Simpson, Ellen, 831
Sinclair, W. K., 644, 645, *893
Sisson, M. A., 1196
Slade, Harry, *324
Smart, Scott, *1052
Smith, C. G., 633
Smith, Donald R., 432
Smith, Frederick M., 192
Smith, Marcus J., 627
Smith, Rodney, 423
Sodeman, William A., 824
Soifer, Charles, 642
Soila, Pekka, 1018
Soloff, Louis A., 638
Soltes, Maury, 1033
Sones, Maurice, 843
Soong, Kenneth Y., 843
Sörensen, Edvin, 1019
Southard, Martha Ellen, *533
Sowerbutts, J. G., 1190
Spanu, G., 1027
Spiegel, E. A., *311
Spies, Tom D., *482
Splettstosser, H. R., 653
Stanford, R. W., 1194
Stauffer, Herbert M., 638, 845, 1182
Stauffer, Richard C., *1102
Stayton, Chester A., Jr., *1161
Stein, George N., 843
Stein, Joseph, 1026
Steinbach, Howard L., 432
Steinberg, Israel, *108
Stewart, Charles Montgomery, 429
St. John, Elmer G., *315
St. Martin, Eugene C., 837
Storrs, Richard P., *290
Stout, Arthur Purdy, 635
Stover, B. J., 648
Stranahan, Allan, 207
Strangways, D. H., 653
Strnad, Franz, 208
Sunder-Plassmann, Paul, 414
Sussman, Marcy L., *127
Sweet, William H., *376
Swoboda, Walter, 613

Tajima, Eizo, 650
Tamayo, Ruheri Perez, *762
Tan, Diana Y. M., *527
Tänzer, A., 1018
Tarazi, Antone K., 433
Taveras, Juan M., 848
Tayebi, Hooshang, *583
Taylor, Lauriston S., 655
Teplick, J. George, 622, 1187
Ter-Pogossian, Michel, 211
Terrafranca, Raymond J., *1070
Thomas, H. Bruce, 210
Thurn, P., 823
Tillander, Hans, 638
Tivey, Harold, *988
Todd, Edwin M., *346
Tondreau, Roderick L., *327
Tranter, F. W., 1029
Trasino, M., 640
Tristan, Theodore A., *562
Trott, N. G., 644
Trübestein, Hermann, 1028
Tubis, Manuel, 210
Tucker, Arthur S., *248
Tugendhaft, Robert I., 630

Uhlmann, Erich M., 1030, 1196
Uzel, Ali Reha, *1132

Valls, Jorge E., 430
Valls, José, 430
Van Brunt, Edmund, *1163
van der Werff, J. Th., 1034
Van Dilla, M. A., 648
Van Roosenbeek, Earl, *934
Varnauskas, Edvardas, 820
v.d. Decken, C. B., 1030
Vermooten, Vincent, 436
Vetter, H., 211, 647
Vickery, Austin L., 646
Vieten, Heinz, 201, 1020
Virshup, Milton, 203
Vlad, Peter, 639
von Gal, Herbert, 622

Wald, Arnold M., 1024
Walinder, Gunnar, 645
Waller, Robert D., 835
Walters, Waltman, 427
Wang, C. C., 846, 1183
Wangensteen, Owen H., 614
Wapshaw, Henry, 428
Ward, Grant E., 622
Warren, Kenneth C., 838
Wasson, William Walter, 820
Watson, T. A., *895
Weber, Danica, 1031
Weiner, Robert S., 628
Weisberger, Austin S., 433
Weitzel, G., 1030
Weller, Carl V., 1013
Wells, Josephine, *1141
Welsh, Richard A., 204
Wessler, Stanford, 624
Westing, S. W., 834
Westman, Axel, 631
Wexlar, Irving B., *693
Wheatley, B. M., 644
Wheeler, H. Brownell, 1033
Whitcomb, Benjamin B., 433
Whitcomb, Wayne P., 634

White, Harvey, 833
Whitehouse, Walter M., *21
Wickbom, Ingmar G., 629
Wilber, M. C., 636
Wilk, S. P., 1024
Williams, E. O., 630
Williams, Edwin G., 656
Williams, I. G., *919
Williamson, Norval L., 426
Willich, E., 1191
Willmann, Karl Heinz, 1020
Wilsey, R. B., 653
Wilson, C. W., 648
Wiltse, Leon L., 1189
Winsten, Joseph, 622
Wolf, Bernard S., *136, 833
Wolf, H. G., 1022
Wong, E., 833
Wood, Ernest H., 848
Woodruff, J. H., Jr., 1024
Wootton, Peter, *929
Wycis, H. T., *311
Youngs, Franklin J., 1190
Yount, Ernest H., *782

Zatuchni, Jacob, 638
Zatzkin, Herbert R., 630, 840
Zeitel, Bertram E., *367, 1189
Zellis, Allan, *1070
Zimmer, James F., 842
Zimmerman, H. M., *351
Zucherman, Sidney D., *47
Züllig, R., 207

DOES NOT CIRCULATE
UNIVERSITY OF MICHIGAN
1956
UNIVERSITY OF MICHIGAN
DEC 1956
MEDICAL LIBRARY

FOUNDED IN 1906 AS THE AMERICAN QUARTERLY OF ROENTGENOLOGY

THE AMERICAN JOURNAL OF ROENTGENOLOGY RADIUM THERAPY AND NUCLEAR MEDICINE

1906 1956

50th Anniversary

OFFICIAL ORGAN OF
THE AMERICAN ROENTGEN RAY SOCIETY
THE AMERICAN RADIUM SOCIETY

LAWRENCE REYNOLDS, Editor

ASSOCIATE EDITORS

HARRY [illegible]SER TRAIAN LEUCUTIA RUSSELL H. MORGAN
EDWARD B. D[illegible]UHAUSER WENDELL G. S[illegible]OTT

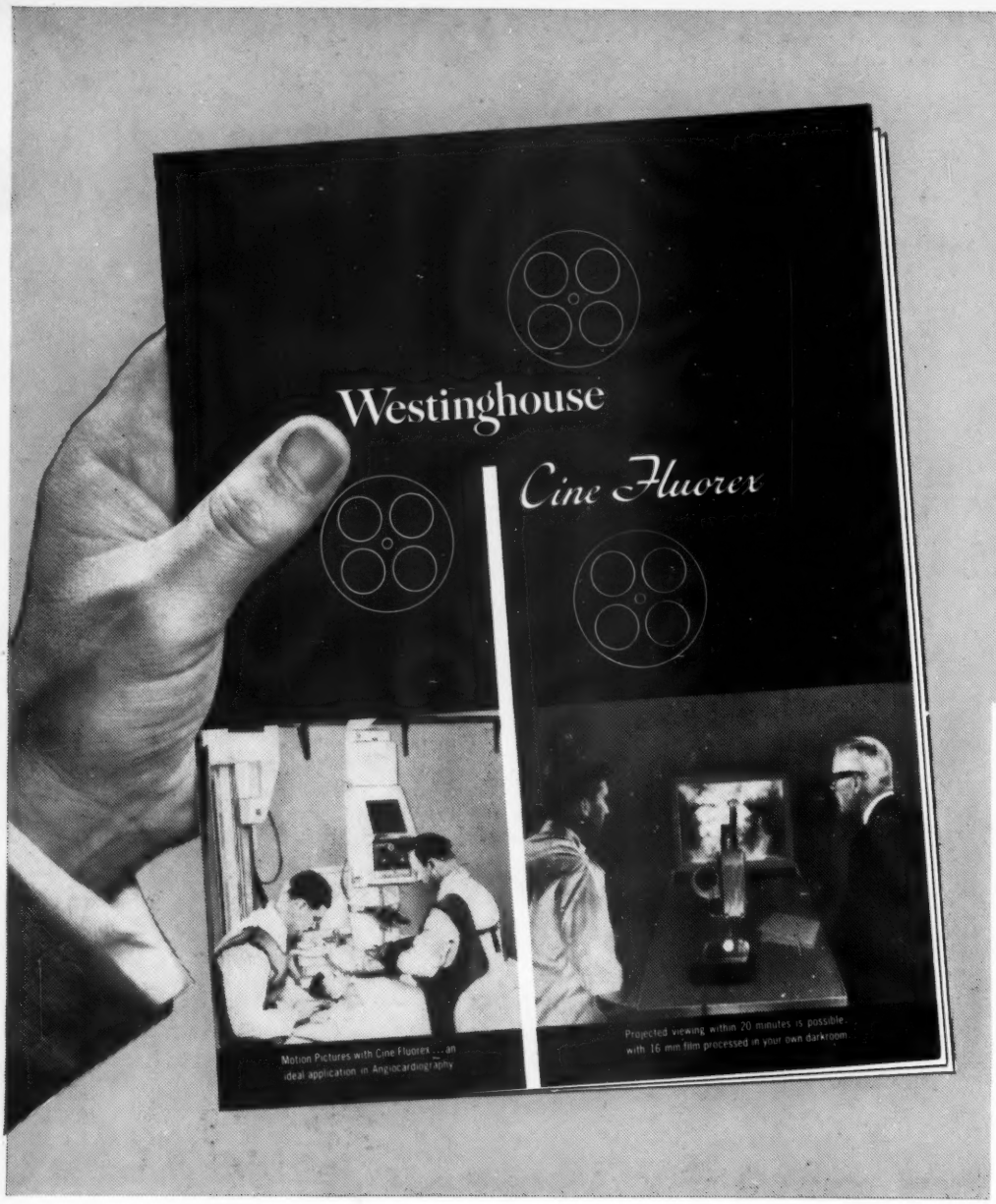
CONSULTING EDITORIAL BOARD

[illegible] C. ABBERSOLD [illegible] C. HODGES U. V. PORTMANN
[illegible] V. BATSON HOWARD B. HUNT MERRILL C. SOSMAN
[illegible] CASSEN [illegible] KIRKLIN LAURISTON S. TAYLOR
JAMES T. CASE [illegible] LAWRENCE OWEN H. WANGENSTEEN
[illegible] [illegible] SHIELDS WARREN
[illegible] [illegible] PENDERGRASS

Issued Monthly for the American Roentgen Ray Society by
CHARLES C THOMAS · PUBLISHER · SPRINGFIELD · ILLINOIS

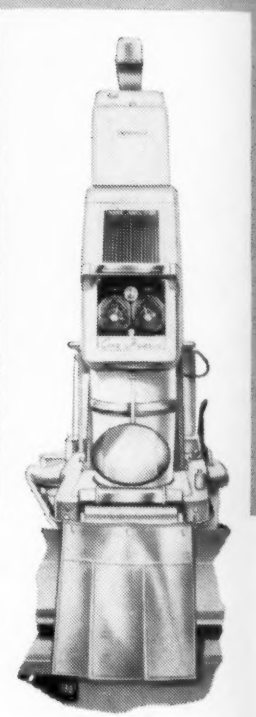
VOLUME 76 DECEMBER, 1956 NUMBER 6

INDEX NUMBER


Westinghouse
Cine Fluorex
Motion Pictures with Cine-Fluorex ... an ideal application in Angiocardiography
Projected viewing within 20 minutes is possible ... with 16 mm film processed in your own darkroom

Have you seen this new 8 page booklet on Cinefluorography?

If you have not already secured your copy of this attractive and informative booklet, send for it today. It describes Cinefluorography in detail, giving you the complete, up-to-date photographic story of how you can use this new medium.



This is Westinghouse Cine Fluorex—the versatile machine that records permanently on 16mm. film the fluoroscopic image you see with the Fluorex.

WATCH

WESTINGHOUSE!

FIRST IN ATOMIC POWER

J-08329

MEDICAL X-RAY

Westinghouse Electric Corporation

X-RAY DIVISION

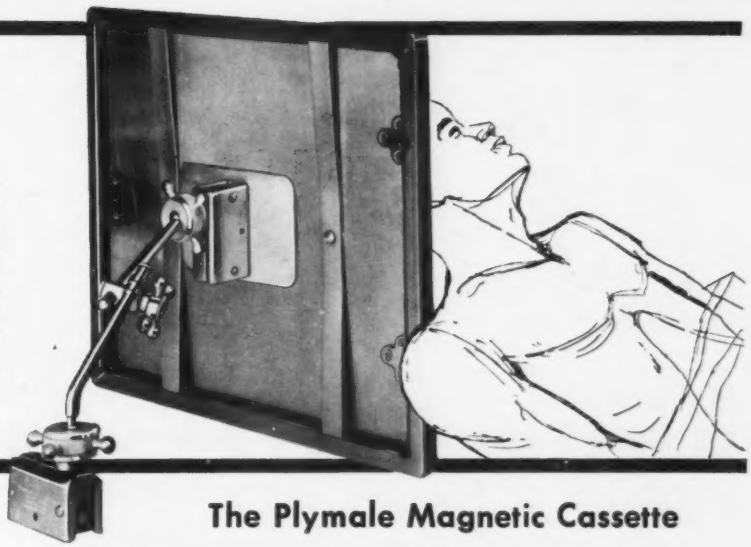
2519 Wilkens Ave
Baltimore 3, Mary

The New PLYMALE MAGNETIC* CASSETTE HOLDER for lateral and oblique x-rays

...enables clear pictures easily, safely

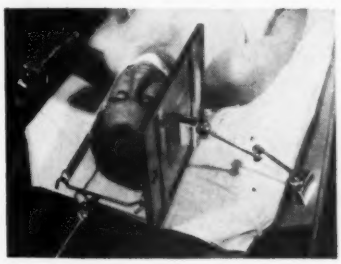
NOW! Eliminate irradiation hazard!

No cassette "hand holding" to steady cassette during long exposure. No danger of irradiation resulting in lost fingers and hands. Using the Magnetic Cassette Holder during the x-ray, your technician can leave the zone where irradiation danger exists.

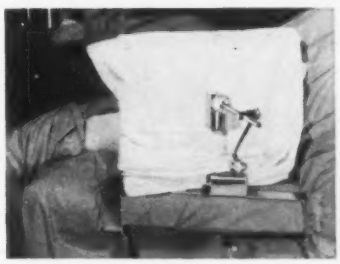


* **125 lb. magnetic pull**
Two powerful magnetic bases provide dependable grip on cassette. The magnetic cassette holder quickly adjusts and locks to instantly hold cassette secure at any position. Each cassette holder is provided with steel plates which attach to the back of any aluminum or magnesium cassette.

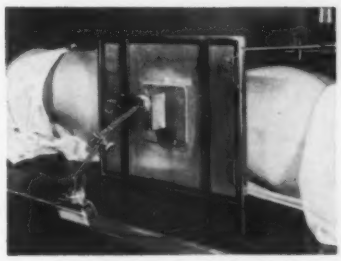
The Plymale Magnetic Cassette Holder's versatility gives proper alignment for consistently clear exposures



EMERGENCIES
The Plymale Magnetic Cassette Holder helps portable x-ray units take easy-to-interpret pictures in emergency room, hospital bed, clinic or on the stretcher. It quickly sets the cassette in place allowing technicians to process emergencies without movement from stretcher or assistance from another technician.



OPERATING ROOM
Mounts on A-P tunnel or on operating table. Permits such difficult exposures as post-reduction hip x-rays without "frog-legging" or disturbing patients. The magnetic cassette holder assures correct cassette positioning and elimination of motion. Result: high quality pictures that are easy to read.



X-RAY ROOM
Indispensable for your myelograms, lateral or oblique hip, skull, cervical spine, angiograms and GI studies. No disturbing of mental patients, the severely injured and fidgeting children. Cumbersome sandbagging is eliminated. Still doctors and technicians never "hand hold" cassettes.

Get complete information today.

Write for Bulletin No. 850

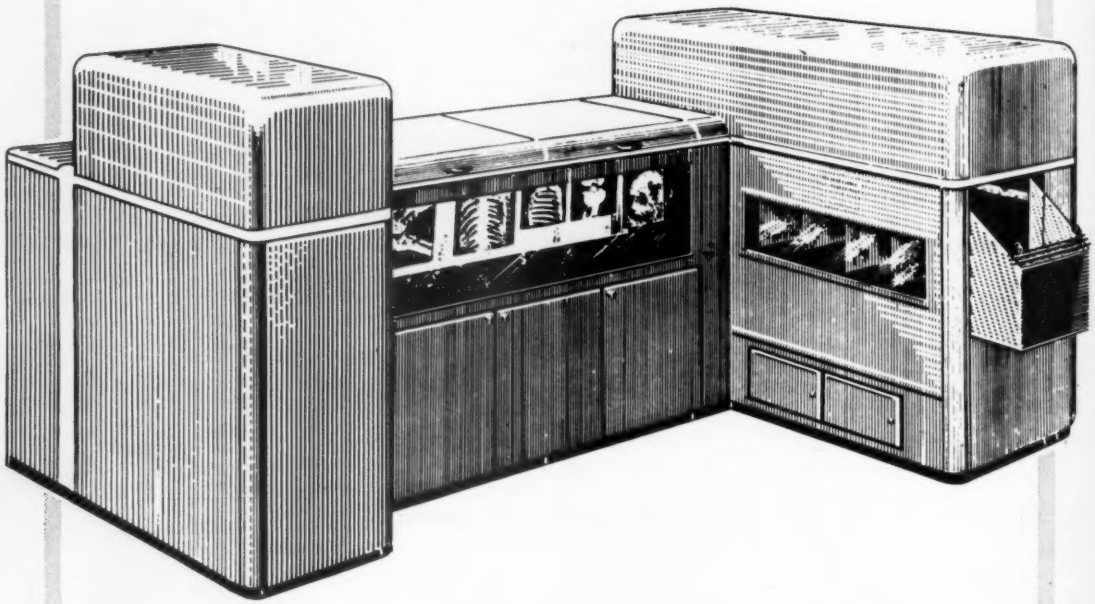
Manufactured by
ENCO Mfg. Co.
Chicago 39, Ill.

Distributed by: GENERAL ELECTRIC • PICKER • WESTINGHOUSE
KELEKET • HALSEY • ZIMMER • NORTH AMERICAN PHILLIPS

ELEMA-SCHÖNANDER

STOCKHOLM, SWEDEN

AUTOMATIC X-RAY FILM PROCESSING MACHINE



- Total Processing Time: 20 minutes
- Capacity: 80 hangers per hour

ELEMA-SCHÖNANDER *units*
now available through your X-Ray Dealer

SCHICK X-RAY • CHICAGO

THE AMERICAN JOURNAL OF ROENTGENOLOGY, RADIUM THERAPY AND NUCLEAR MEDICINE

VOL. 76 DECEMBER, 1956 No. 6

CONTENTS

Benefits to Mankind through Integration of Physiology and Radiology. W. EDWARD CHAMBERLAIN, M.D. 1037

Osteoid Osteoma. ROBERT A. FLAHERTY, M.D., DAVID G. PUGH, M.D., AND MALCOLM B. DOCKERTY, M.D. 1041

Osseous Coccidioidomycosis: A Chronic Form of Dissemination. J. W. BIRSNER, M.D., AND SCOTT SMART, M.D. 1052

The Migration of a Fracture-Transfixing Pin from the Humerus into the Mediastinum. MICHAEL BURMAN, M.D., SOL GROSSMAN, M.D., AND STEFAN ROSENAK, M.D. 1061

Unusual Sequela Following Pinning of Medial Clavicular Fracture. VICTOR KREMENS, M.D., M.Sc. (MED.), AND FRANK GLAUSER, M.D., M.Sc. (MED.), F.A.C.S., F.I.C.S. 1066

Large Foreign Body Cyst with Migration of Smith-Petersen Na'l. RAYMOND J. TERRAFRANCA, M.D., ALLAN ZELLIS, M.D., AND ROMAN BABYN, M.D. 1070

Primary Epidermoids of the Skull, Including a Case with Malignant Change. P. V. HAIG, M.D. 1076

Examination of the Atlanto-Axial Joint Following Injury; With Particular Emphasis on Rotational Subluxation. GEORGE JACOBSON, M.D., AND DENIS C. ADLER, M.D. 1081

Secondary Ossification Centers and the Intra-Articular Ossicle. LEE A. HADLEY 1095

Fracture Dislocation of the Ankle with Fixed Displacement of the Fibula behind the Tibia. JOHN J. FAHEY, M.D., LEO T. SCHLENKER, M.D., AND RICHARD C. STAUFFER, M.D. 1102

The Os Sustentaculi. HERMAN C. MARCH, M.D., AND RUSSELL I. LONDON, M.D. 1114

Benign Osteopetrosis; Report of 9 Cases. ARNOLD D. PIATT, M.D., GERALD A. ERHARD, M.D., AND JACOB S. ARAJ, M.D. 1119

(*Contents continued on p. iv*)

Benign Chondroblastoma of Bone; Its Roentgen Diagnosis. ROBERT S. SHERMAN, M.D., AND ALI REHA UZEL, M.D. 1132

Osteitis Condensans Ilii. JOSEPHINE WELLS, M.D. 1141

Fracture of the Hyoid Bone; Presentation of One Case. MAXWELL H. POPPEL, M.D., AND ROBERT O. CHRISTMAN, M.D. 1144

Roentgenologically Demonstrated Myelomatous Areas of the Skeleton Proving to Be Due to Metastases from Epithelioma. HANS H. BASSÖE . . 1146

OSTEOMYELITIS VARIOLOSA. ROBERT W. BERTCHER, M.D. 1149

Clinical Significance of the Supracondyloid Process of the Humerus; Case Report. NATHAN KRISS, M.D. 1154

Asymmetry of Osteophytosis in the Thoracic Spine. GORDON J. CULVER, M.D., AND HERBERT S. PIRSON, M.D. 1157

Ischial Epiphysiolysis. CHESTER A. STAYTON, JR., M.D. 1161

A Method of Measuring the Femoral Neck in Surgical Treatment of Fractures of the Hip. EDMUND VAN BRUNT, B.A. 1163

Officers 1166

Editorial

The Fifty-seventh Annual Meeting of the American Roentgen Ray Society 1167

The Scientific Exhibit 1172

The Commercial Exhibit 1179

Abstracts of Radiological Literature 1180

Subject Index to Volume 76 1197

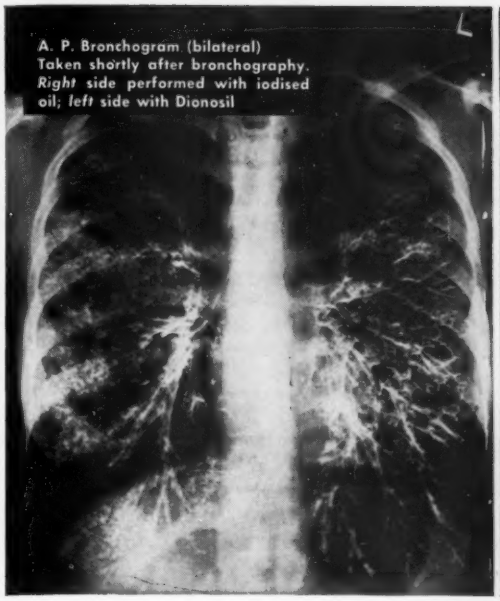
Author Index to Volume 76 1215

CONSOLIDATED INDICES

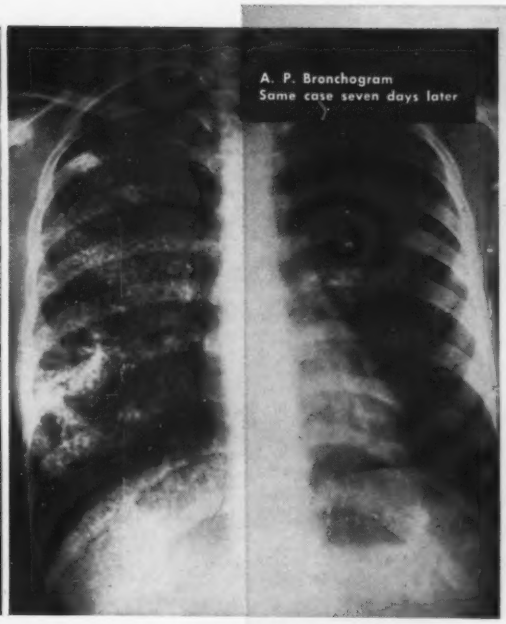
Volume I (1903-1937) $12.50
Volume II (1938-1942) 5.00
Volume III (1943-1947) 12.50
Volume IV (1948-1952) 13.50

Order From:
CHARLES C THOMAS · PUBLISHER
301-327 East Lawrence Avenue
Springfield, Illinois

(Purchasers outside U.S.A. should send cash with order. Delivery, postpaid, guaranteed.)



A. P. Bronchogram (bilateral)
Taken shortly after bronchography.
Right side performed with iodised oil; *left* side with Dionosil



A. P. Bronchogram
Same case seven days later

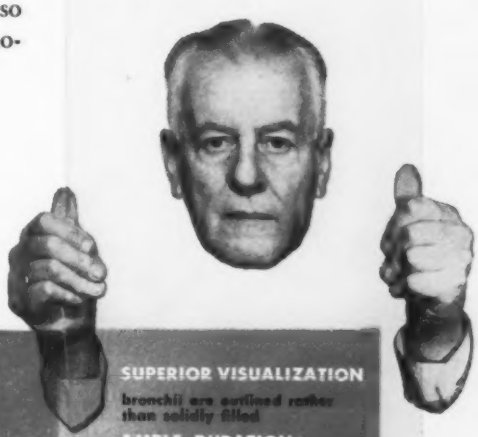
spontaneous clearing

by absorption in four days or less

Within four days of a Dionosil bronchogram the radiopaque has been absorbed into the blood stream and excreted in the urine. Disappearance is *spontaneous* without resort to hacking expectoration and postural drainage. The study is diagnostically trustworthy; bronchii are outlined rather than blocked out. Alveolar flooding is avoided. With benefits so evident, Dionosil stands preeminent today among bronchographic media.

DIONOSIL

Available in two forms: DIONOSIL, an aqueous suspension (iodine content about 30%) and DIONOSIL OILY, a suspension-in-arachis oil (iodine content 34%) of propyliodone*.
*n-propyl ester of 3:5 diiodo-4-pyridone-N-acetic acid



EASY ADMINISTRATION

by instillation or intubation

The Gianturco catheter introducer "feeds" the catheter into the trachea single-handed. A battery-operated seed lamp illumines the field which is clearly visible in the mirror on the tongue arm. Ask for reprint "Bilateral Bronchography: New Medium and Technic", Cesare Gianturco and G. A. Miller.

SUPERIOR VISUALIZATION
bronchii are outlined rather than solidly filled

AMPLE DURATION
shadows persist for at least thirty minutes allowing ample time for examination

RAPID ABSORPTION
lung fields are radiologically clear in three to four days

COMPLETE EXCRETION
absorbed and excreted in the urine

NO IODISM
no breakdown to free iodine

Picker x-ray

25 South Broadway, White Plains, N. Y.

GENERAL INFORMATION

Manuscripts offered for publication and other correspondence relating to the editorial management and books for review should be sent to Dr. Lawrence Reynolds, Editor, 110 Professional Building, Detroit 1, Michigan. Contributions may be sent in foreign languages and will be translated if found acceptable. Original articles are published with the understanding that they are contributed exclusively to THE AMERICAN JOURNAL OF ROENTGENOLOGY, RADIUM THERAPY AND NUCLEAR MEDICINE.

A certain number of illustrations will be supplied free of cost; but special arrangements must be made with the Editor and Publisher for excess illustrations and elaborate tables.

Fifty reprints are furnished without charge to authors. Additional reprints may be purchased according to a scale of prices that accompanies galley proofs.

Correspondence regarding subscriptions, advertisements, and other business relating to THE AMERICAN JOURNAL OF ROENTGENOLOGY, RADIUM THERAPY AND NUCLEAR MEDICINE should be addressed to Charles C Thomas, Publisher, 301–327 East Lawrence Avenue, Springfield, Illinois.

Issued monthly. Annual Subscription: United States, U. S. Possessions, Pan-American Union and Spain, $15.00; Canada, $16.00; other foreign countries, $17.00. Current single numbers, $1.50. Distributed in the British Commonwealth of Nations by Blackwell Scientific Publications, Ltd., 24–25 Broad Street, Oxford, England. Yearly price £6.5.0. UNESCO COUPONS provide conveniences for payment of subscriptions.

Manuscripts should be typewritten, with double spacing, and good margins (not on thin paper) and the *original* should be sent to the Editor. The author should keep a carbon copy, as the original is not returned. The name of the author should appear on each sheet of manuscript. Tabular materials should be typed on separate sheets: likewise bibliographical lists, footnotes, etc.

Drawings and charts for reproduction should be made in black (*never* in blue). Photographic prints of plates or slides on glossy paper produce the best half-tones.

All photographs and drawings intended for illustrations should be numbered, the top plainly indicated, and an abbreviated title of the paper placed on the back of *each one*.

Legends for illustrations should be typewritten in a single list, double spaced, with numbers corresponding to those on the photographs and drawings, instead of attaching each legend to its corresponding figure.

Care in preparation of bibliographies will save much time and correspondence. Each reference in a bibliography should include the following information in the order indicated: Name of the author with initials; title of the article; name of the periodical; year, volume, and pages. It is requested that the authors use the following as model:

1. Olcott, C. T., and Dooley, S. W. Agenesis of the lung of an infant. Am. J. Dis. Child., 1943, 65, 766–780.

The month should be given if the reference is to an issue of the current year. An alphabetical arrangement of authors is preferred.

The author should always place his full address somewhere on his manuscript. This is very important and is often omitted.

For information regarding membership in the American Roentgen Ray Society address the Chairman of the Executive Council, Dr. E. B. D. Neuhauser, 300 Longwood Ave., Boston, Massachusetts.

For information regarding the program of the annual meeting of the American Roentgen Ray Society, address the President-Elect, Dr. Wendell G. Scott, 35 North Central Ave., Clayton 5, Missouri.

For information regarding membership in the American Radium Society, address the Secretary, Dr. Theodore R. Miller, 139 East 36th Street, New York, New York.

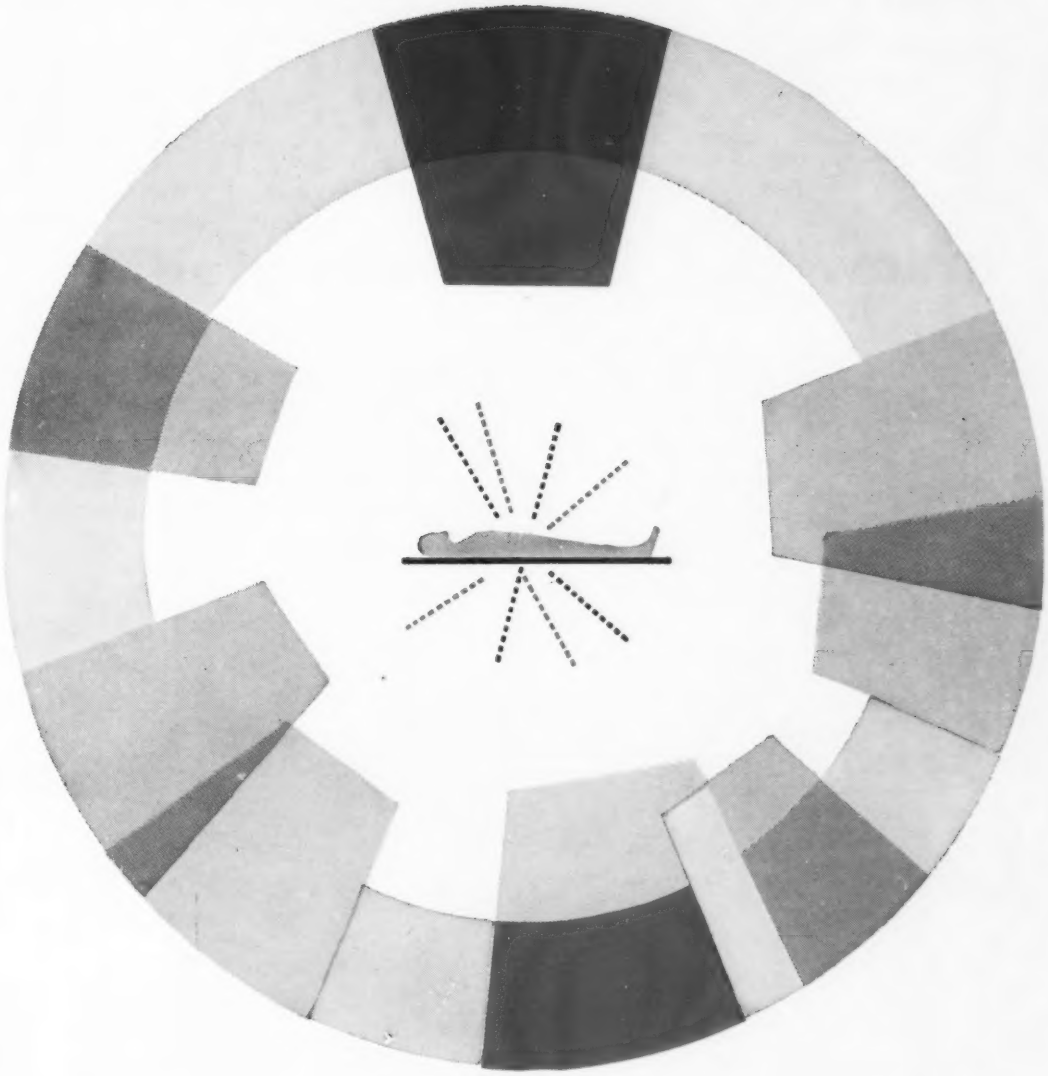
For information regarding the program of the annual meeting of the American Radium Society, address the President, Dr. Norman A. McCormick, 1687 Wyandotte St. East, Windsor, Ontario, Canada.

THE AMERICAN JOURNAL OF ROENTGENOLOGY, RADIUM THERAPY AND NUCLEAR MEDICINE is owned. maintained by, and in the interests of, the American Roentgen Ray Society, Inc. It is issued monthly by Charles C Thomas, Publisher, 301–327 East Lawrence Avenue, Springfield, Illinois. THE AMERICAN JOURNAL OF ROENTGENOLOGY, RADIUM THERAPY AND NUCLEAR MEDICINE does not hold itself responsible for any statements made or opinions expressed by any contributors in any article published in its columns.

Entered as second-class matter February 10, 1930, at the postoffice at Springfield, Illinois, and Menasha, Wisconsin, under the Act of March 3, 1879. Accepted for mailing at the special rate of postage provided for in the Act of February 28, 1925, embodied in Paragraph 4, section 538, P.L. and R. authorized February 10, 1930. Delivery is not guaranteed. Replacements are not guaranteed nor promised, but will be attempted if extra single copies are available and only if requested within 30 days from first of month following publication (17th of month) for domestic subscribers and 60 days for foreign subscribers. A 30 day notice of a change of address is requested. When ordering a change of address, send the Publisher both the old and new address.

Copyright 1956 by American Roentgen Ray Society, Inc. All rights reserved. This issue may not be reproduced, in whole or in part, in any form (except by reviewers for the public press) without written permission from the publisher. Copyrighted in the British Commonwealth by Blackwell Scientific Publications, Oxford. No part may be duplicated or reproduced without permission of publishers.

PRINTED IN THE U.S A.



when **radiation sickness** jeopardizes further treatment . . .

THORAZINE* **controls severe nausea and vomiting**

and permits radiotherapy to be carried out as planned[1]

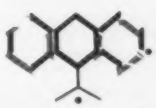
In 95 per cent of 84 patients, radiation sickness was successfully controlled:

"Never before had any preparation for combating radiation sickness been used with such satisfactory results."[2]

1. O'Connell, D.: J. Fac. Radiologists 6:214 (Jan.) 1955.
2. Marks, J.H.: New England J. Med. *250*:999 (June 10) 1954.

Smith, Kline & French Laboratories, Philadelphia

*T.M. Reg. U.S. Pat. Off. for chlorpromazine, S.K.F.



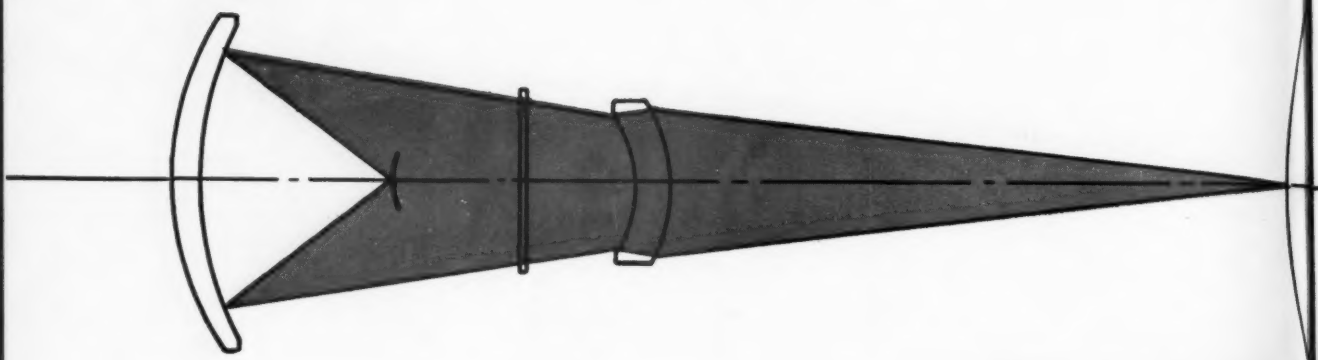
'Thorazine' is available in ampuls, tablets and syrup (as the hydrochloride), and in suppositories (as the base).

Full range Fairchild-Odelca line

gives DIRECT X-RAY QUALITY

in low-cost photofluorography

For the first time, top-quality diagnostic photofluorography is available in all five major categories; mass chest survey . . . hospital admissions X-ray . . . serial and skull photofluorography . . . and even general radiography. The five cameras in the Fairchild-Odelca line all give optical speeds 400% to 500% faster than those now available in refractive lens cameras.



The reason for their exceptionally high optical speed (plus 400% increase in detail resolution) is the Bouwers Concentric Mirror Optical System. You use lower tube current and 75 to 80% reduction in exposure time—resulting in approximately 1/10th the radiation previously required in photofluorography. Retakes are eliminated because both voluntary and involuntary motion are stopped completely. The small film sizes provide remarkable savings in cost of operation.

Get complete details from your regular X-ray equipment supplier, or direct by addressing Industrial Camera Division, Fairchild Camera and Instrument Corp., 88-06 Van Wyck Expressway, Jamaica 1, N. Y., Dept. 160-44V1.

In-Line

Angle-Hood

70MM SKULL CAMERA

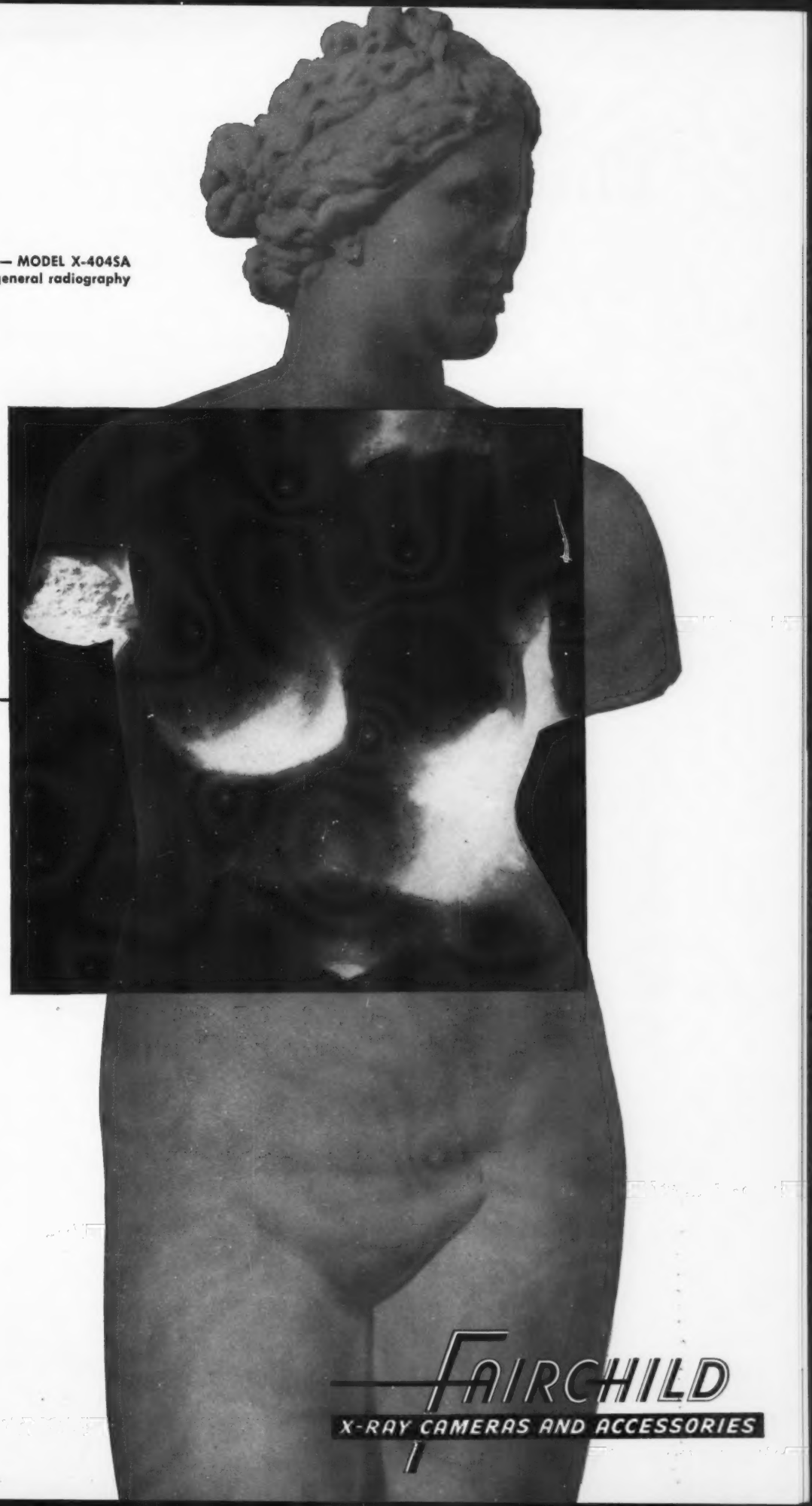
Serial photofluorography of the skull, heart great vessels or of any 10" square body area (1 to 6 exposures per second). The angle- model facilitates under-table use or (using cameras) bi-plane photofluorography is poss

70MM SUPER SPEED

Complete versatility of these two models per under-table, over-table or upright use for m chest survey or Hospital admissions X-ray. patient is missed.

In-Line

Angle-Hood



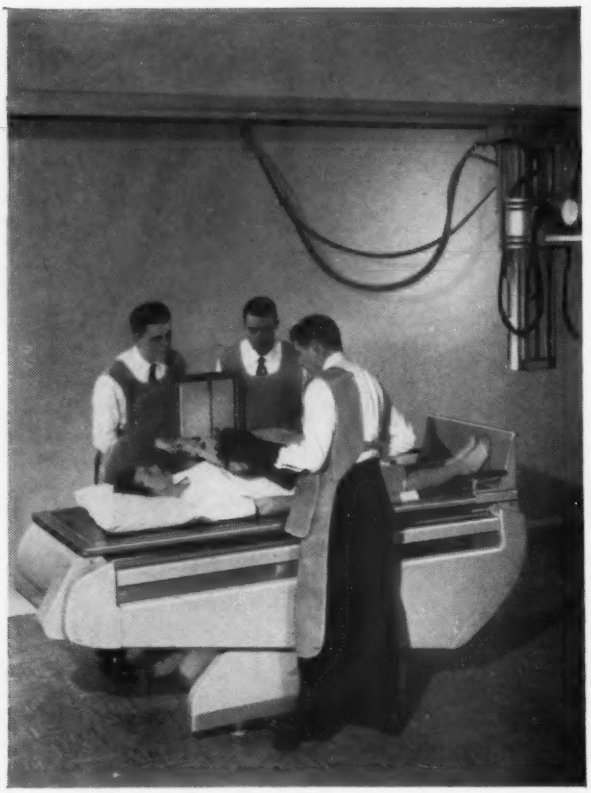
4" x 4" ULTRA SPEED — MODEL X-404SA
is fully evaluated for general radiography

Aphrodite:
Ancient replica of Greek
statue, circa 300 B.C.
Courtesy of
The Metropolitan Museum
of Art

FAIRCHILD
X-RAY CAMERAS AND ACCESSORIES

The G-E REGENT

Your first audit shows the difference!



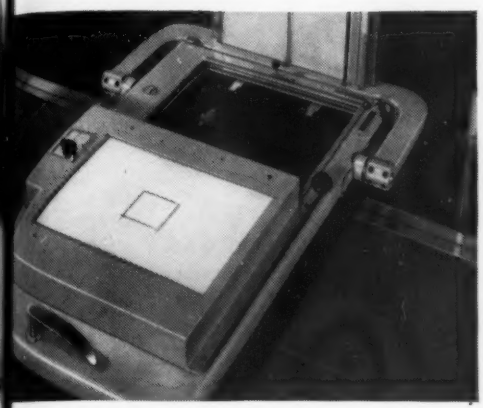
Yes, your first audit will underline the soundness of your decision to buy this remarkable, moderately priced diagnostic x-ray unit. This is when you will truly appreciate the added productivity made possible by the progress-pacing advantages General Electric builds into the REGENT.

Unobstructed Fluoroscopic Area — even at rear of table—speeds all examinations. Lightweight spot-film unit maneuvers easily. All controls at your fingertips. Full-range screen coverage—21″ laterally, 55″ longitudinally. Interchangeable use of 8″ x 10″ and 10″ x 12″ spot-film cassettes. Choice of 18 spot-film exposure areas.

G-E MAXISERVICE® RENTAL PLAN . . . a way to enjoy all the productive REGENT advantages without initial capital investment. Single, monthly charge includes all apparatus expenses —rental, periodic adjustment, tubes and parts.

Overhead Tube Hanger
No interfering floor rails or tube stands. Flexible, easy-to-position hanger provides any target-film distance up to 60″ for horizontal radiography . . . up to 54″ for cross-table examinations . . . up to 90″ for vertical technics.

makes every day far more productive!

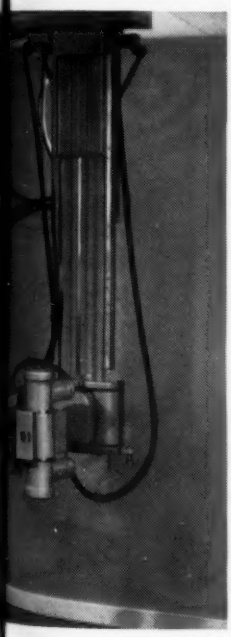


Consistent Spot-Films

Exclusive G-E sealed phototimer is unaffected by room-lighting variations. Constantly assures desired film density regardless of patient thickness or size of spot-film exposure area.

Controlled Angulating Speed

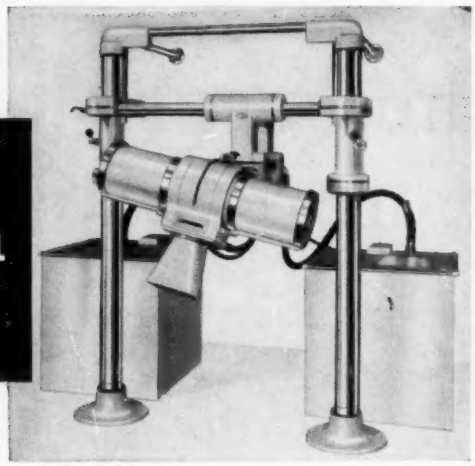
Table's powerful hydraulic drive gives you absolute control of tilting speed from vertical to full 45° Trendelenburg —especially beneficial for myelography. Radiation-protection panels close Bucky slot during fluoroscopy.



Investigate these and numerous other REGENT advantages that increase x-ray productivity. Ask your G-E x-ray representative for complete details . . . or write X-Ray Department, General Electric Company, Milwaukee 1, Wisconsin, for Pub. A-121.

Progress Is Our Most Important Product

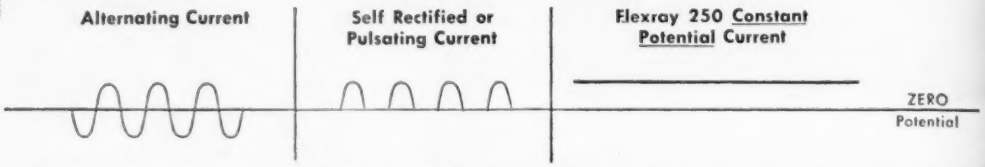
GENERAL ELECTRIC



What advantages does FLEXRAY 250 KV CONSTANT POTENTIAL offer you for...

DEEP RADIATION THERAPY?

1 COMPARE THE WAVE FORM AND RADIATION PRODUCED



The self rectified circuit utilizes only half of the alternating current cycle. See how the Flexray 250 uses the full cycle producing approximately TWICE THE QUANTITY OF RADIATION. The rise and fall of self rectified voltage produces x-rays of varying wave lengths. Flexray 250 generators provide practically ripple-free direct current that produces uniform x-rays of the QUALITY DESIRED, depending on voltage selected.

2 COMPARE THE QUANTITY AND QUALITY OF X-RAYS THAT REACH THE PATIENT

Voltage	Current	Filter	Self Rectified or Pulsating Current R/M	Self Rectified or Pulsating Current Half Value Layer	Flexray 250 Constant Potential Current R/M	Flexray 250 Constant Potential Current Half Value Layer
250KV	15MA	0.5mm Cu+1mm Al	54	1.3mm Cu	102	1.75mm Cu
250KV	15MA	1.0mm Cu+1mm Al	40.5	1.8mm Cu	80	2.1mm Cu

Flexray 250 gives you *greater quality* expressed in roentgens per minute and higher quality expressed in half value layer. The superiorities enable you to successfully treat conditions where other units might not prove effective.

LEARN MORE ABOUT FLEXRAY 250 CONSTANT POTENTIAL APPARATUS

And the complete Standard X-Ray Line

See your Standard dealer, or write for an illustrated folder.

Standard X-RAY COMPANY

1932 North Burling Street, Chicago 14, Illinois

The first

MAJOR STEP IN TWENTY YEARS IN SYNTHESIZING IMPROVED CONTRAST MEDIA

TOOK PLACE AT Mallinckrodt®

"Other materials have followed uroselectan and only recently a new and different compound was synthesized by Dr. V. H. Wallingford* in this country which has led to the creation of urokon, hypaque and miokon, all of which are greatly superior to any of their forerunners."[1]

* Dr. V. H. Wallingford of Mallinckrodt Chemical Works synthesized this compound known as Urokon Sodium Brand of Sodium Acetrizoate in 1945.

1. Nesbit, Reed: Editorial, Radiology and Its Contribution to Urology, The American Journal of Roentgenology, 75:995 (May, 1956).

Normal intravenous urogram made with MIOKON Sodium 50% in a twelve-year-old male. Note excellent filling of calyces, pelvis and ureters.

miokon · RESULT OF CONTINUING RESEARCH

miokon® SODIUM 50%

especially for INTRAVENOUS UROGRAPHY

MIOKON was perfected in the laboratory several years ago, clinically tested under controlled conditions and used routinely in the field for over a year before its general introduction last December.

96% DIAGNOSTIC FILMS[1]
notably safe

90.4% showed no reactions.
9.6% experienced one or more side reactions in a study of 1500 cases.[1]

1. Nicolai, C. H.: MIOKON, A New Intravenous Urographic Medium, J. Urol. 75:759 (April, 1956).

Miokon is produced by Mallinckrodt, makers of **UROKON®**

Used successfully in millions of cases for these various techniques...
INTRAVENOUS UROGRAPHY, RETROGRADE PYELOGRAPHY, CHOLANGIOGRAPHY, ANGIOCARDIOGRAPHY, TRANSLUMBAR ARTERIOGRAPHY, NEPHROGRAPHY and CEREBRAL ANGIOGRAPHY
Urokon Sodium (Brand of Sodium Acetrizoate) is available for specific uses in three concentrations: 30%, 50%, and 70%.

MALLINCKRODT CHEMICAL WORKS Mallinckrodt®

SECOND & MALLINCKRODT STREETS, ST. LOUIS 7, MO. • 72 GOLD STREET, NEW YORK 8, N. Y.
CHICAGO • CINCINNATI • CLEVELAND • DETROIT • LOS ANGELES • PHILADELPHIA • SAN FRANCISCO
IN CANADA: **MALLINCKRODT CHEMICAL WORKS LIMITED** • 378 ST. PAUL STREET W., MONTREAL

An Improved Gallbladder Evacuant
For the Successful Demonstration
of Biliary Ducts in
Oral Cholecystography

NEO-CHOLEX

the Modern, Rapidly Acting, Palatable, Concentrated Fat Meal, Always Ready at Hand for Immediate Convenient Administration

Modern routine diagnostic procedure in oral cholecystography places increased emphasis on duct visualization. Roentgenography of the gallbladder alone is no longer considered adequate.

The preoperative demonstration of the cystic, common and at times hepatic duct, is giving new and more exacting diagnoses of biliary abnormalities, and is invaluable to the surgeon in both the plan and performance of the operative procedure. Visualization of the biliary ducts following administration of the newer tri-iodo contrast media is readily accomplished by careful positioning of the patient with multiple exposures at *suitable intervals after ingestion of an adequate fatty meal.*

1. Cholecystogram before NEO-CHOLEX administration.

2. Cholecystogram 8 minutes after NEO-CHOLEX administration.

3. Cholecystogram 40 minutes after NEO-CHOLEX administration.

Samples on request

BELL-CRAIG, INC. 270 Lafayette Street
New York 12, New York

CONFIDENCE

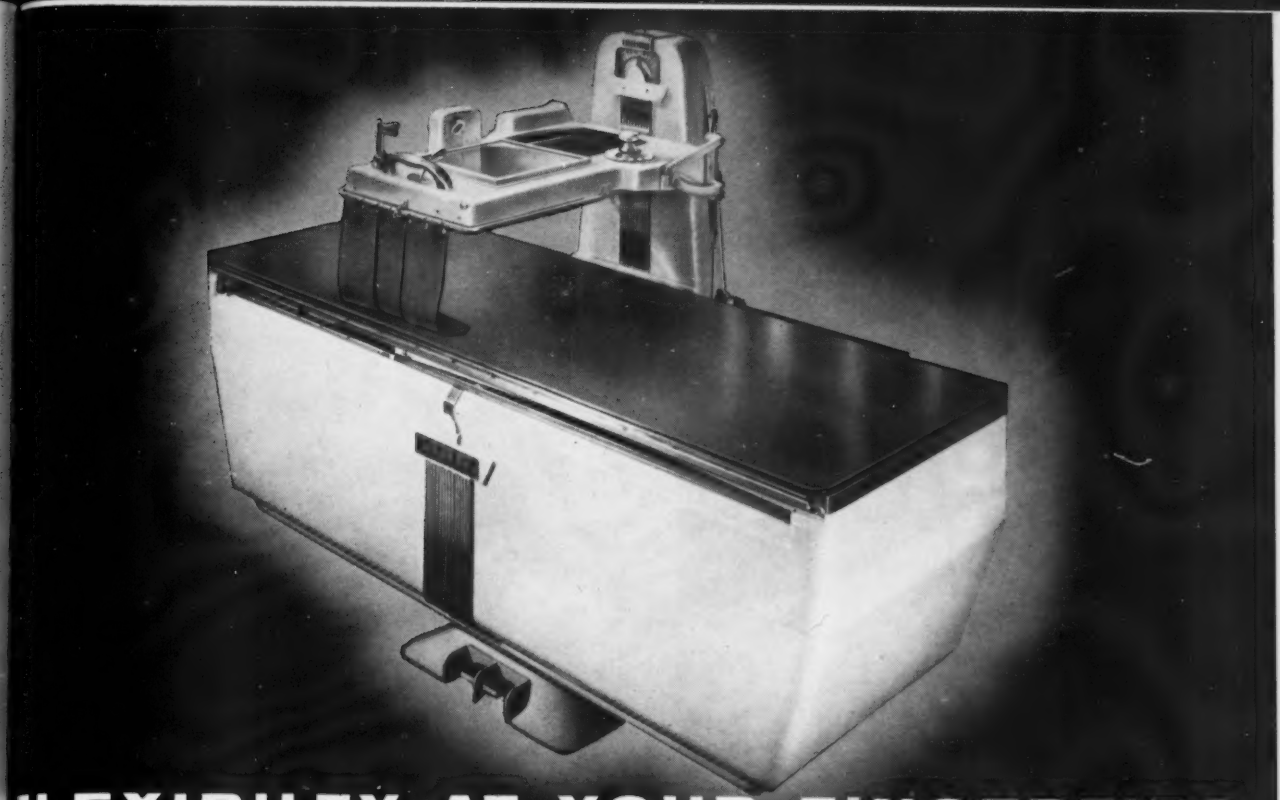
earned through experience

Confidence ripens slowly—whether it's a patient's faith in her doctor, or a doctor's esteem for the instruments of his profession. For example, over the years Ilford X-ray film has earned the complete confidence of radiologists everywhere. *High speed* that reduces risk of involuntary movement on the part of the subject and sharpens detail; *gradation* that unfailingly produces a wide range of opacities with correct contrast; *fineness of grain* and greater *reproducibility* . . . these qualities are products of exacting research and highest technical standards respected the world over. Ilford X-ray materials are available now in the U.S.A. Contact your regular source of supply, or write to the address below.

Ilford Red Seal X-ray Film • Ilfex (non-screen film) • Ilford Intensifying Screens

ILFORD Red Seal & Ilfex | X-ray Films

Made in England by ILFORD LIMITED, your source in U. S. A. is ILFORD INC., 37 West 65th Street, New York 23, New York. Your source in Canada is W. E. Booth Co. Limited, 12 Mercer Street, Toronto 2B, distributors for Ilford Limited.



FLEXIBILTY AT YOUR FINGERTIPS

LEKET *Fleetwood* 90/90 X-RAY TABLE

ision machining and polishing of contact surfaces eliminates the need for power assists.

w it is possible to concentrate fully on radiological procedure and enjoy lete flexibility of table operation, as well as safe, dependable control the new Keleket Fleetwood 90/90 X-ray Table.

eful engineering design has made the mechanical functioning of the et 90/90 Table completely dependable and affords easy, simple control ient positioning. Owing to its unique double duty counterbalance system mirror finish of all bearing surfaces, the fluoroscopic carriage can be d with only a feather touch. The possibility of interruptions to patient e because of failure of power assists is eliminated.

And there are other benefits with Fleetwood Tables:

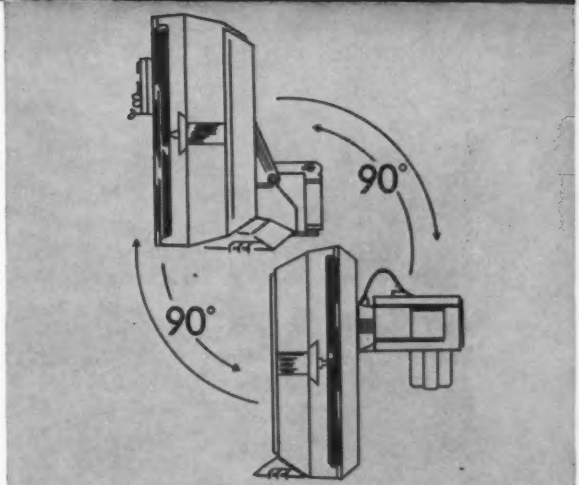
- ***Stepless, variable speed control through fingertip operation.***
- ***Effortless positioning of fluoroscopic assembly without motor assist.***
- ***Unequalled radiation protection regardless of operator and patient position.***
- ***Protective safety feature provided by "floating" safety bottom which stops table motion instantly . . . protects objects on the floor.***
- ***Modern fluoroscopic shutter design provides sharper beam definition and minimum patient-shutter distance.***

y we suggest that you investigate the exceptional features of the Keleket etwood table? You'll find it's ideal for your office or hospital.

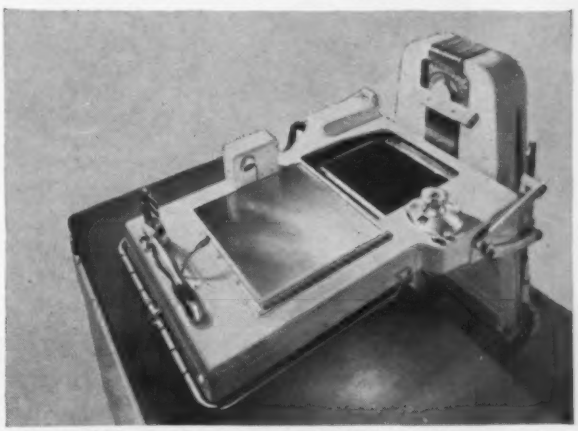
Write today for information on Fleetwood 90/90 Tables.

Kelley-Koett . . . Oldest Name in X-Ray

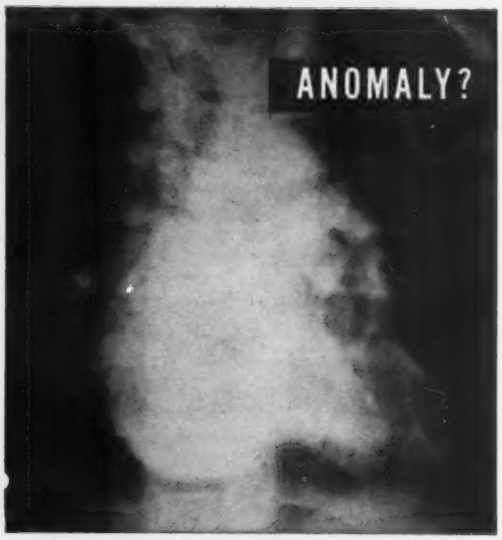
KELEKET X-RAY CORPORATION
130 High Street, Boston 10, Massachusetts

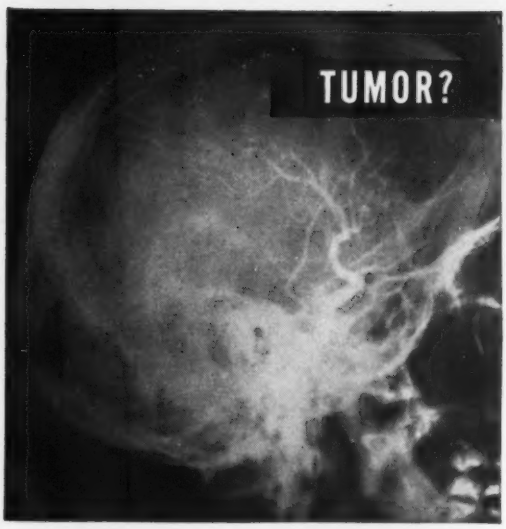


14 years of experience and research with leading roentgenologists and radiologists have led to the development of the exceptional 90/90 flexibility of the Keleket Fleetwood Table.



Essential Fleetwood accessory is this Keleket Multimatic 8 x 10 Spot Film Tunnel, for dependable automatic spot film positioning. Also available with Scholz or Leishman Spot Film Devices





Locate it with
Diodrast

In the diagnosis of urinary tract disorders and, more recently, cerebral, mediastinal and peripheral vascular abnormalities in millions of cases, Diodrast has earned a reputation as a reliable radiopaque.

DIODRAST® 35%

BRAND OF IODOPYRACET INJECTION
Ampuls of 10 cc., 20 cc. and 30 cc.

for
Intravenous Urography,
Cerebral Angiography,
Arteriography,
Venography and
Direct Cholangiography

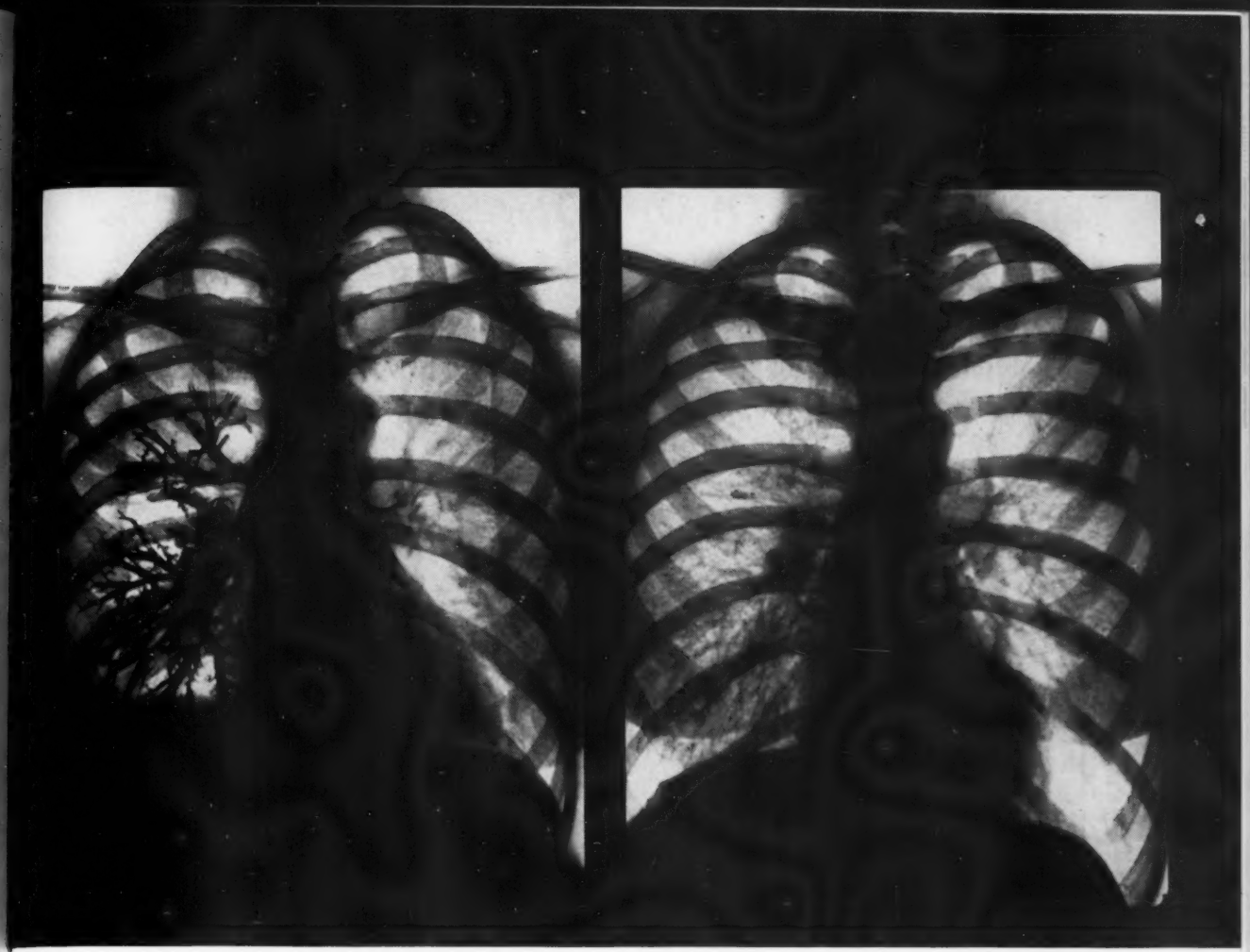
DIODRAST® 70%

Ampuls of 20 cc. and 50 cc.

for
Angiocardiography,
Aortography and
Selected Cases of Arteriography

WINTHROP LABORATORIES
NEW YORK 18, N. Y. • WINDSOR, ONT.

Diodrast, trademark reg. U. S. & Canada



Bronchogram of right lung with VISCIODOL. Note clear outline of bronchi and absence of alveolar filling.

Chest x-ray three days after bronchogram. Note clearing of VISCIODOL and fluid level in right hilar cavity.

"...radio-opaque agent of choice in bronchography."[1]

VISCIODOL*

new LIPIODOL *diagnostic*

Rapidly eliminated from the lungs[1] • "Rarely penetrates the alveoli"[1]

New VISCIODOL* offers many advantages for bronchography. Its excellent degree of contrast and its greater viscosity assure controlled, uniform outlining of the bronchi without alveolar filling. VISCIODOL is retained sufficiently long for complete x-ray study, yet is readily eliminated by expectoration and postural drainage, providing clear lung fields within 48 to 72 hours. No shadows remain to confuse interpretation of follow-up films or repeat bronchograms. Possessing none of the irritating properties of the water-soluble media,[1] it does not necessitate high levels of anesthesia.

Now available here, VISCIODOL has been in use throughout the world for over five years, and reports covering thousands of bronchographies have been published. The extensive bibliography on VISCIODOL is available on request.

Supplied in 15 cc. vials.

*VISCIODOL, T.M., is the trade name for the well-tolerated LIPIODOL®-sulfanilamide suspension, a development of Guerbet Laboratories.

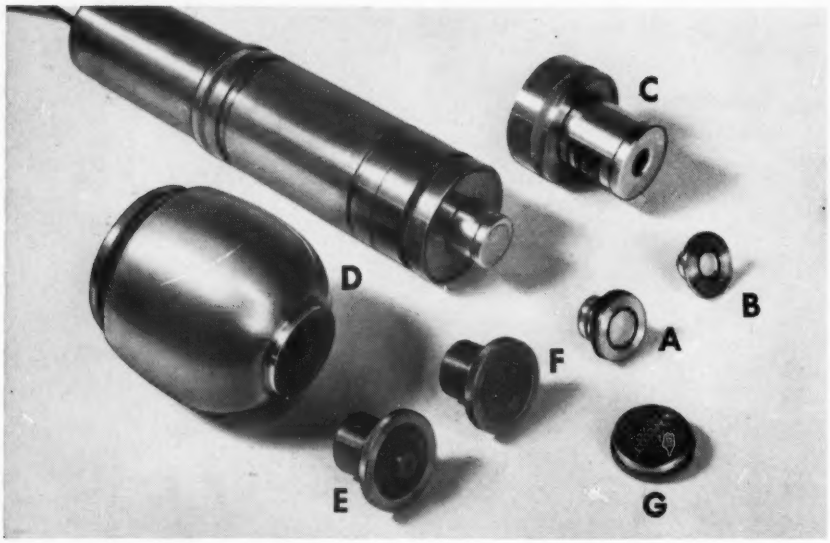
1 Burrascano, J. J.: Sea View Hosp. Bull. *15*:149 (July) 1955.

FOUGERA

E. FOUGERA & COMPANY, INC • 75 Varick Street, New York 13, N.Y.

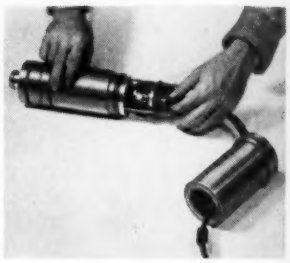
27556

NEW! MULTI-PURPOSE SCINTILLATION DETECTOR WITH OPTIONAL ACCESSORIES...



Optional accessories include (A) ¾", (B) ½", and (C) well scintillation crystals. Large lead collimator (D) provides exceptional side shielding, accepts 20° flat field collimator (E) or special focusing collimator (F). Alpha and beta phosphors (G) are interchangeable with standard 1" crystal.

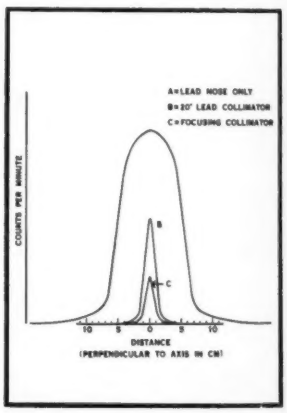
Standard probe is quickly converted into a scintillation well counter by changing crystals and adding inexpensive base and shielding.



Easily accessible switch in housing permits changing from preamplifier output for scaler or ratemeter use to cathode follower output for gamma ray spectrometry work.

FOR USE WITH STANDARD SCALERS OR GAMMA RAY SPECTROMETERS

Nuclear-Chicago's new Model DS-5 is the first completely self-contained scintillation detector designed for basic counting or for the revolutionary techniques of gamma ray spectrometry, "pin-point" depth focusing, or source scanning. This is a unique instrument—providing unmatched performance for your present requirements and quickly convertible to the many new applications you'll face in the future. The most advanced scintillation counter on the market, the new DS-5 is inexpensive, reliable and easy to operate. Write today for detailed specifications.



Response Curve to I^{131}

SPECIFICATIONS

Crystal—Normally supplied with 1" x 1" NaI(T1) crystal. Other size crystals and phosphors optional. 1" x 1½" lucite light pipe. Crystal can be exposed directly in path of radiation.

Phototube—DuMont 6292 protected by a magnetic shield.

Shielding—Internal ¼" x 3" lead ring. External lead nose provides 1½" or more of lead at sides. Acceptance angle at rear is less than 25°.

Amplifier—New one-tube feedback amplifier provides gain of two and cathode follower positive output for spectrometer use; gain of 10 with negative output for normal use. Band width sufficient for 1 microsecond resolution. Provides pulse height limiting for spectrometer use.

Operation (with 1" x 1" crystal)—Plateau: 250 volts; 2% slope/100 volts. Background: Crystal exposed—1250 cpm; with lead nose—160 cpm; with additional collimation—95 cpm. Detection efficiency (1 microcurie I^{131} at 10 cm): 4400 cpm.

nuclear-chicago

Nuclear Instrument and Chemical Corporation
257 West Erie Street, Chicago 10, Illinois
LEADERS IN MAKING RADIOACTIVITY COUNT

UP TO

3,000 CURIES Co^{60}

IN ONE

IRRADIATOR

$12,000.00 *

INSTALLATIONS AT:

MEMORIAL CENTER

PARKE-DAVIS

FORT KNOX

*NOT INCLUDING COBALT

BAR-RAY PRODUCTS, INC.

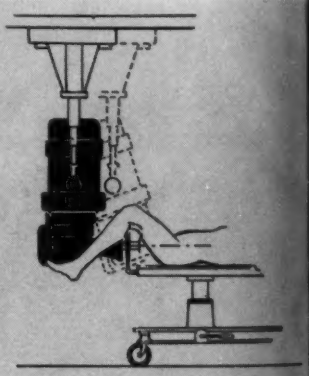
BROOKLYN 32, N.Y.

NEW for therapy

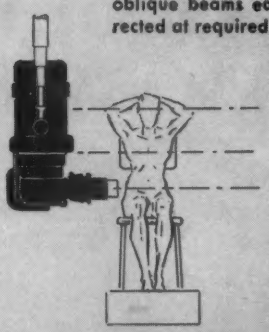
clears the floor

New Ceiling Mount for the Picker VANGUARD x-ray Therapy Unit leaves the floor completely free for maneuvering the treatment cart. Same lightweight, compact, free-swivelling (yet firm-locking) Vanguard tubehead that makes patient setup so quick and easy. Same automatic technic selection through Vanguard's unique Monitor Control. Easily mounted to conventional 9-foot ceiling . . . or higher (10′ 6″) with adaptor extensions.

wide range overhead *longitudinal* travel facilitates multiportal positioning without having to shift patient or stretcher.



plus ample cross traverse to let you quickly locate the x-ray tube target exactly where you need it.



vertical, horizontal and oblique beams easily directed at required height.

radiation turret revolves full circle . . . combined with other movements imparts remarkable flexibility for beam direction.

tubehead tumbles end-over-end. Positions like this quickly and easily obtainable.

ceiling-mounted VANGUARD x-ray therapy unit

NEW for radiography

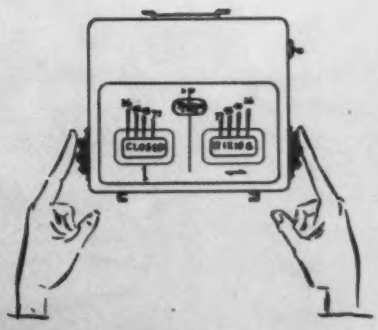
...pounds the field

New Picker Radiographic Collimator takes the guesswork out of localizing and centering field-to-film. More, by controlling scattered radiation, it produces better radiographic contrast, reduces radiation to the patient. You simply set the dial for the film size and TFD you want; whereupon the Collimator casts upon the patient's skin a bright image which bounds exactly the area that will appear on the film. *No more, no less* . . . with a precision that puts an end to wasteful retakes.

direct "dialing" of any square or oblong field up to 17" x 17" (at 36" TFD).

double diaphragm Collimator reduces scatter; gives better contrast, less penumbra, less radiation to patient.

bright image on skin shows exact area which will appear on film. Automatic centering by crosshairs splitting brightfield. Automatically calibrated for each film size at all conventional target-film-distances.



adjustment within easy reach on front of cone.

PICKER
radiographic
collimator

Picker
X-ray

25 South Broadway, White Plains, N. Y.

COME OUT OF THE DARKROOM

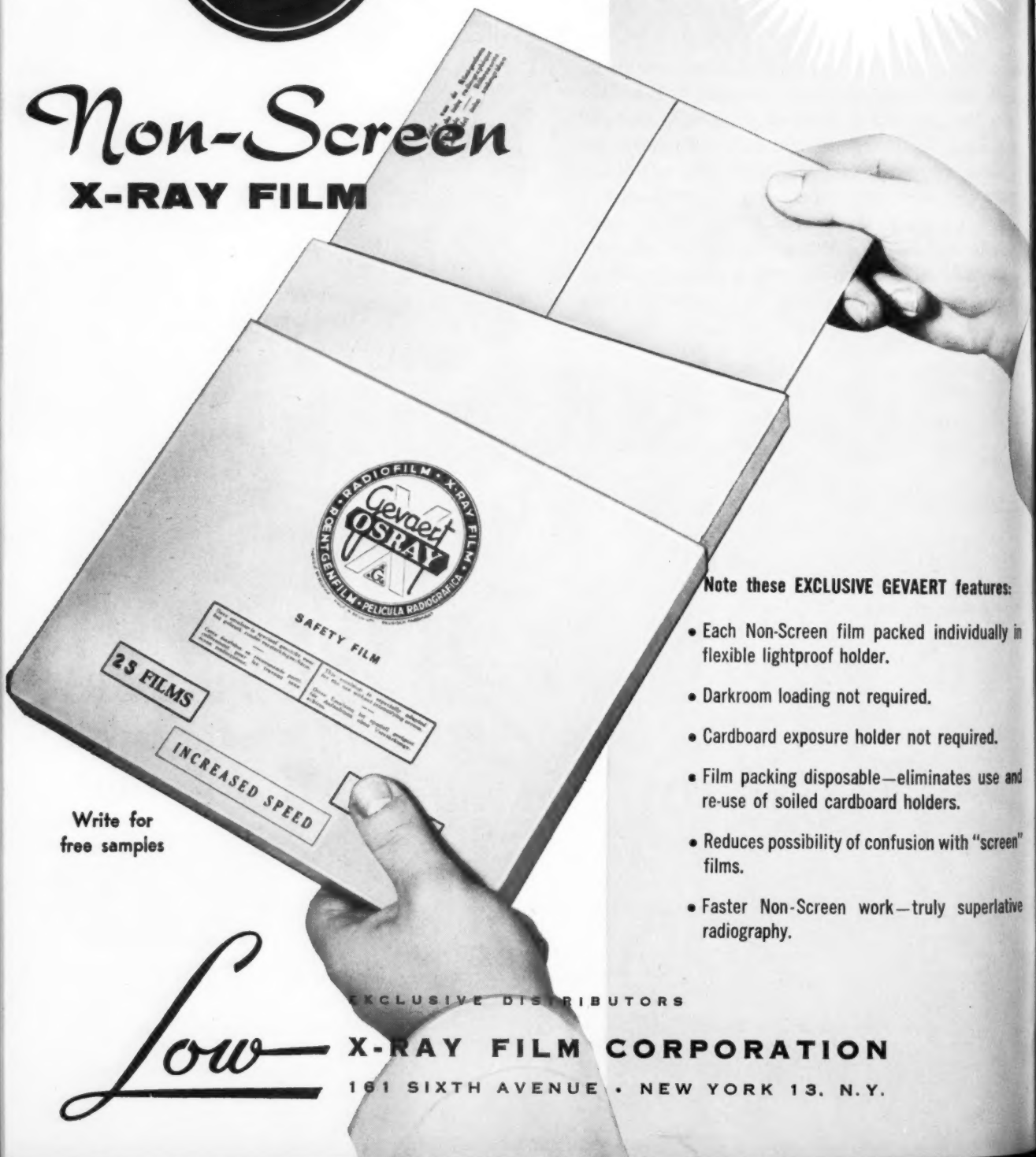
WITH THE *new*

Gevaert

LIGHTPROOF!

Each film is individually self-contained in its own flexible LIGHTPROOF container.

Non-Screen
X-RAY FILM



Write for free samples

Note these EXCLUSIVE GEVAERT features:

- Each Non-Screen film packed individually in flexible lightproof holder.
- Darkroom loading not required.
- Cardboard exposure holder not required.
- Film packing disposable—eliminates use and re-use of soiled cardboard holders.
- Reduces possibility of confusion with "screen" films.
- Faster Non-Screen work—truly superlative radiography.

EXCLUSIVE DISTRIBUTORS

Low X-RAY FILM CORPORATION

161 SIXTH AVENUE • NEW YORK 13, N.Y.

1946-1956 years of accomplishment...

..... an eventful decade for Radelin. During this period of growth, nourished by the widening acceptance of our products, Radelin has introduced a new competitive spirit in the x-ray screen field. This alone resulted in substantial savings to screen users. Noteworthy contributions have also been made through the introduction of new products and services. *Consider this record:*

- Introduced the first photoradiographic screen, Type PF (Blue), free from significant lag.
- First to offer a cleanable and protected fluoroscopic screen as a standard item.
- Developed a fluoroscopic screen, Type FC (Yellow), providing finer detail than conventional screens.
- Manufactured the first detail screen, "High Resolution" having adequate speed for general radiography.
- Made available the first screen cleaner specifically formulated for this purpose.
- First to offer an improved intensifying screen with an aluminized back coat.
- The only screen manufacturer to offer a complete inspection service throughout the year.
- Designed a practical field instrument for checking the brightness of fluoroscopic screens.
- Produced a precise instrument to determine degree of dark adaptation.
- Developed 548 experimental screens for radiologists and the x-ray industry.

Yes, we believe the past 10 years have been fruitful. To our many friends who have contributed to our success, a sincere "Thank You" in appreciation. We look confidently to the future and assure you that you can always rely on Radelin products—conceived through progressive research to better serve radiologists.

RADIUM

Rādelin Division

UNITED STATES RADIUM CORP.

Morristown, New Jersey

Offices: Chicago, Ill., and No. Hollywood, Calif.

Affiliates: Radelin-Kirk Ltd., Toronto, Ont., Canada
United States Radium Corp. – Europe, Geneva, Switzerland

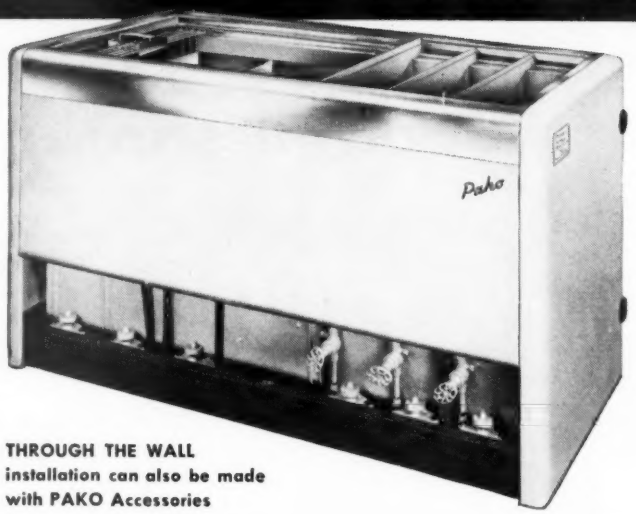
For greater control of manual film processing use

PAKO *Model 38* FILMTANX

The system provided in the PAKO Model 38 Filmtanx encourages greater control of processing procedures. The continuous flow of processed films permits better organization of all work in the department. By eliminating the "rush and wait" of manually processing films in batches, more work can be accomplished with less effort.

The saving in time . . . the elimination of lost motion . . . the increased efficiency in your X-ray department soon pay for the installation of PAKO Model 38 Filmtanx.

See how easily YOU can control your manual processing of X-ray films. For complete information on PAKO Model 38 Filmtanx write direct to:



THROUGH THE WALL installation can also be made with PAKO Accessories

PAKO CORPORATION

1010 LYNDALE AVE. NO. • MINNEAPOLIS 11, MINN.

THE CURV-X CASSETTE

CAMPBELL X-RAY CORP.—Boston 15, Mass.
Or Your Dealer

These are your hands, doctor

YOU HAVE ONLY ONE PAIR

Insist upon leaded leather
IT CANNOT CRACK

Order from your dealer, or:

LIBERTY PROTECTIVE LEATHERS, Inc.
17-29 Burr Street
Gloversville, New York

The Vertebral Column Considered as a System

THE SPINE

A Radiological Text and Atlas

By BERNARD S. EPSTEIN, M.D.

Chief, Department of Radiology, The Long Island Jewish Hospital, New Hyde Park, New York

THE many specific diseases and other conditions which affect the vertebral column and its contents are discussed fully in this beautifully illustrated text and atlas. Dr. Epstein correlates the *clinical and pathological aspects* of these diseases with the associated *radiologic changes.* The vertebral column is considered as an individual system and is, through this fresh approach, reviewed in full relationship to osseous disease, diseases of the central nervous system, metabolic disturbances, effects of trauma, neoplastic diseases and nutritional disturbances.

The text is the result of more than twenty years of observation of radiological and clinical variations of vertebral column disease. In addition to conventional technics applicable to spinal radiography, full consideration is given to myelography, body section radiography and stereoradiography. Classical changes, as well as variations and similarities with pathologic states, are detailed. One of the many features is the extensive use of large, original, unretouched roentgenograms, which are woven into the text. All of them show precise and meticulous radiographic technic.

Embryologic consideration, functional aspects and radiological examination of the normal spine are taken up first. This is followed by developmental anomalies and other malformations of the spine. Congenital and metabolic disorders and endocrine disturbances are treated separately, followed by sound discussions of arthritis, tuberculosis, Paget's disease, and other inflammatory, degenerative and noxious diseases. Other pertinent subjects which receive full consideration include neoplasms, traumatic changes, and diseases of the intervertebral discs. An extensive *Bibliography* includes almost 1300 references.

This sound text and atlas is a highly useful work for radiologists, neurologists, neurological surgeons, orthopedists, pediatricians, internists, general practitioners, and all who do their own spinal column roentgenology.

539 Pages, 7" × 10". 721 Illustrations on 331 Figures. $16.50.

(Published June, 1955)

LEA & FEBIGER WASHINGTON SQUARE PHILADELPHIA 6 PA.

18 YEARS of integrity have helped us to become America's largest buyers of

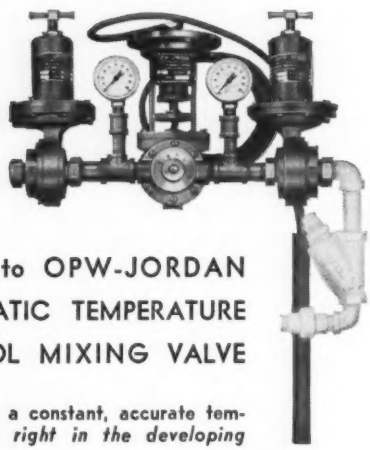
USED X-RAY FILM

- We purchase all makes and sizes from any point in the nation, and pay the freight cost.
- We remit in advance if desired, or promptly after receipt and tally of the value.
- Write for prices today. We will send shipping labels, and direct your film to our nearest plant.

DONALD McELROY, INC.

111 W. Jackson Blvd., Chicago 4, Ill.

DON'T Be Plagued With FOGGY, BLURRED NEGATIVES



Change to OPW-JORDAN AUTOMATIC TEMPERATURE CONTROL MIXING VALVE

- Maintain a constant, accurate temperature, *right in the developing tank.*
- Eliminate developing tank temperature fluctuations due to changing room temperatures and water line pressures.
- Eliminate weaknesses of manually operated control devices.

Currently in use in hundreds of X-Ray laboratories. Write for Bulletin J-201.

Contact your X-Ray supply dealer or write or phone

JORDAN CORPORATION
DIVISION OF OPW CORPORATION
6013 Wiehe Road
Cincinnati 13, Ohio
ELmhurst 1-1352

NEW MICRO X-RAY RECORDER

MICROFILMS X-RAYS, CHARTS AND ALL HOSPITAL RECORDS

Check These Exclusive Advantages

Two lens—give full 15½" x 18½" or 10" x 12" coverage with diagnostic detail and density for physicians' reference. Lightens darkened or overexposed films by special panel switch. 1100 to 4400 X-Ray films per roll—saves you money. Uses 4 films—lets you use special films for economy.

The Micro X-Ray recorder will pay for itself in space and filing cabinets saved.

ONLY **$1295**

Write for free folder

MICRO X-RAY RECORDER, INC.

3755 W. LAWRENCE AVENUE • CHICAGO 25, ILLINOIS

Urologia Internationalis

EDITORES

HEINRICH HEUSSER
Basel (Schweiz)

PETER A. NARATH
Yorktown Heights, New York (U.S.A.)

CO-EDITORES

H. BOEMINGHAUS (Düsseldorf)
M. F. CAMPBELL (Miami, Fla.)
R. COUVELAIRE (Paris)
F. MAY (München)
E. MINGAZZINI (Roma)
P. MINGERS (Bruxelles)
A. DE LA PEÑA (Madrid)
A. VILLANUEVA (Mexico)
H. P. WINSBURY-WHITE (London)

REDACTORES

L. F. ALCORTA, Buenos Aires (Argentina)
T. BANDERAS BIANCHI, Santiago (Chile)
R. C. BEGG, Johannesburg (Southern Africa)
H. BOEMINGHAUS, Düsseldorf (Deutschl.)
M. F. CAMPBELL, Miami, Florida (U.S.A.)
J. C. CHRISTOFFERSEN, København (Danmark)
R. COUVELAIRE, Paris (France)
P. DEUTICKE, Wien (Österreich)
R. DE FREITAS, São Paulo (Brasil)
E. HJORT, Oslo (Norge)
E. G. JOSEPH, Jerusalem (Israel)
E. LJUNGGREN, Goeteborg (Sverige)
L. LOPEZ, Caracas (Venezuela)
S. A. MACDONALD, Montreal (Canada)
F. MAY, München (Deutschland)
G. MAYOR, Zürich (Schweiz)
E. MINGAZZINI, Roma (Italia)
P. MINGERS, Bruxelles (Belgique)
R. MOLINA, Habana (Cuba)
H. MORTENSEN, Melbourne (Australia)
C. DE MOURA, Lisboa (Portugal)
A. DE LA PEÑA, Madrid (España)
S. PETKOVIĆ, Beograd (Jugoslavija)
F. TSUCHIYA, Tokyo (Japan)
A. VILLANUEVA, Mexico (Mexico)
J. A. WEIJTLANDT, Amsterdam (Nederland)
H. P. WINSBURY-WHITE, London (Engl.)

153 COLLABORATORES

2 volumes of 6 parts each are published yearly. Subscription price per volume U.S.$12.00

BASEL 11 (Switzerland) S. KARGER NEW YORK

Subscriptions may also be ordered through

ALBERT J. PHIEBIG
P.O. Box 352
White Plains, N.Y.

SMIT-ROENTGEN

Makers of Precision X-Ray Products

SMIT RÖNTGEN

Finest in Workmanship Highest in Performance

- **SMIT-ROENTGEN "Heavy Duty Lightweight Cassette"**
- **SMIT-ROENTGEN "Golden Grid"**

  Standard "60" *Fineline "75"* *Jewel "110"*

  Available in any focal range and ratios suitable for both Conventional and High-KV Technique
- **SMIT-ROENTGEN "Golden Grid Cassette"**

  embodies the excellent qualities both of the SMIT-ROENTGEN "Golden Grid" and the "Heavy Duty Lightweight Cassette"
- **SMIT-ROENTGEN "Golden Grid Channel"**

  the ingenious new "Smit-Roentgen" device of a Golden Grid attachment to readily interchangeable conventional cassettes.

Consult your X-Ray Dealer or for information contact

PTE

PHYSICIANS' TECHNICAL EQUIPMENT CO.

Suppliers to the American X-Ray Industry

1519 W. North Ave. **Milwaukee 5, Wis.**

See our Booth No. 104 at the Meeting of the Radiological Society of North America in Chicago, December 2-7.

The only film badge service in America designed to meet the needs of the modern radiology department.

We invite your inquiry.

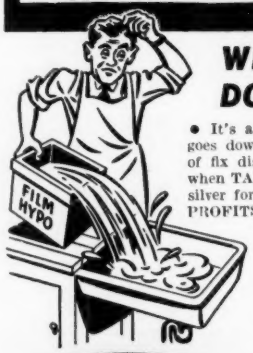
R. S. LANDAUER, JR. AND CO.

24 Plaza
Park Forest, Illinois

"America's Finest Film Badge Service"

ATTENTION:

RADIOLOGISTS:



WHY POUR "CASH" DOWN THE DRAIN?

• It's a fact—up to $1.57 worth of SILVER goes down the drain forever with each gallon of fix discarded! Why allow this tragic waste when TAMCO Silver Collectors will salvage this silver for re-use—and pay you handsome extra PROFITS!

And it's so simple—Just place TAMCO Collectors in fix tanks and forget until they're coated with silver. Then send to us for smelting. We mail you check at once for half the market value of the silver—and send you FREE replacement collector for next loading!

TAMCO SILVER COLLECTORS

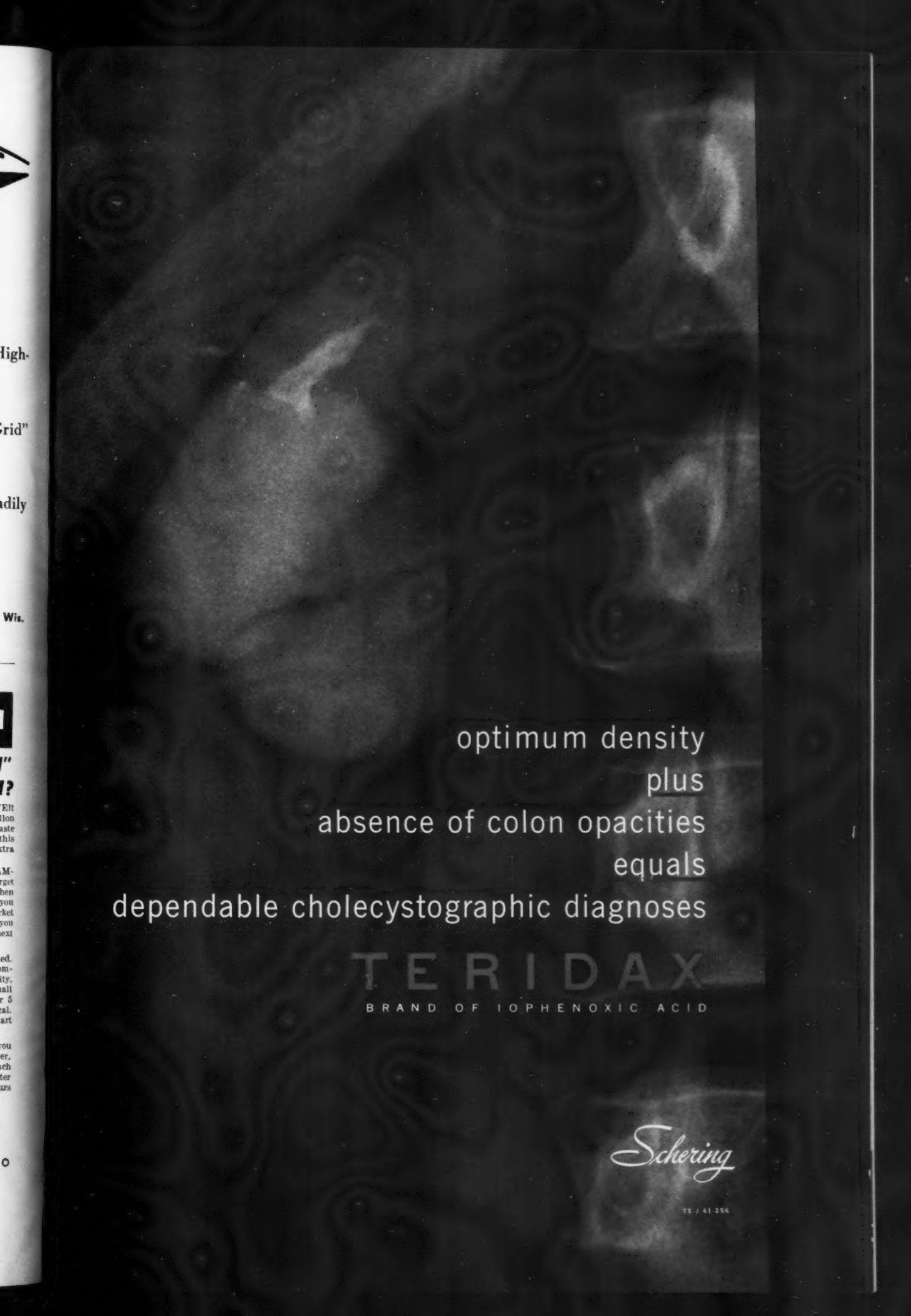
TAMCO units are self contained. They come ready to use—small, compact, not in the way. No electricity, no mess, no bother! The small initial collector charge ($5.00 for 5 gal. Size "A"; $7.00 for 10 gal. Size "B") is the only cost to start years of extra earnings!

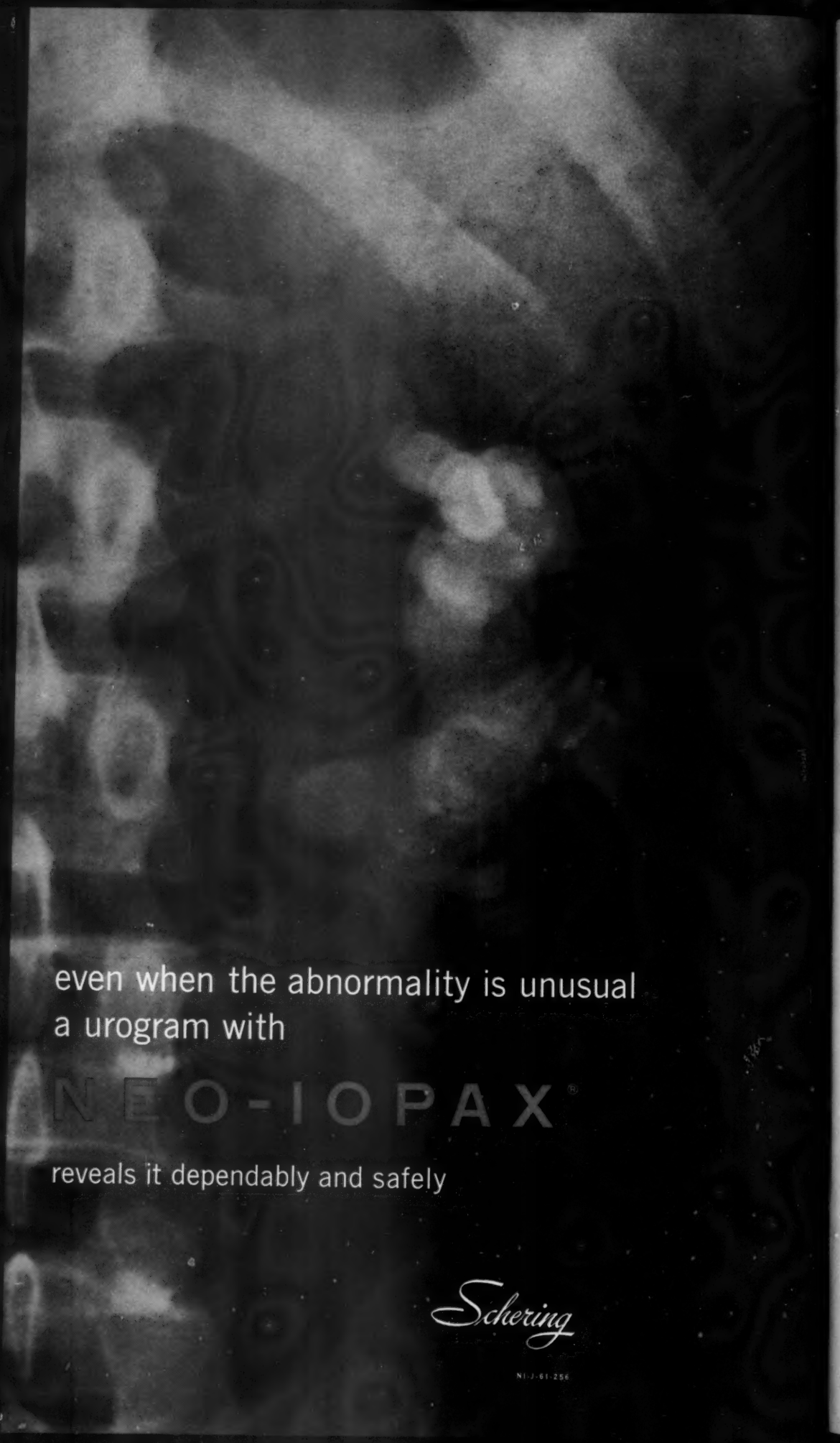
Besides providing CASH income—TAMCO Collectors also SAVE you time, work, and expense! By constant removal of the retarding silver, the active efficient life of fix is lengthened 50%—eliminates 1 of each 3 changes of fix—cuts chemicals cost 1/3! And you get better, faster fixing all the time. Start to benefit from TAMCO now! Order yours today!

OVER 20,000 TAMCO UNITS IN USE!

STATES SMELTING & REFINING CO.

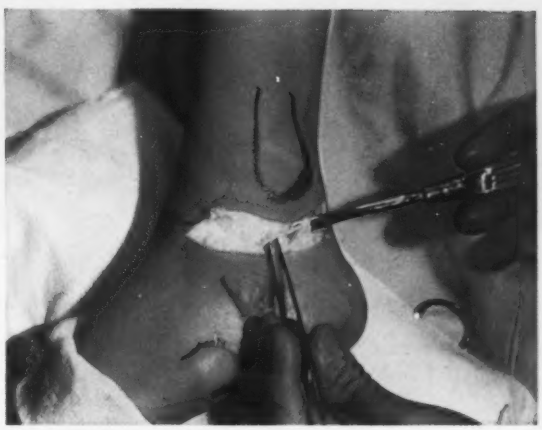
615 VICTORY STREET • LIMA, OHIO


optimum density
plus
absence of colon opacities
equals
dependable cholecystographic diagnoses
TERIDAX
BRAND OF IOPHENOXIC ACID
Schering
TX-J 61-256

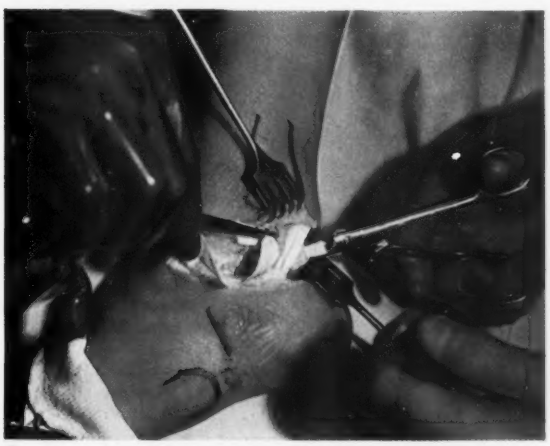

even when the abnormality is unusual
a urogram with
NEO-IOPAX®
reveals it dependably and safely
Schering
NI-J-61-256

STABILIZATION OF POSTPOLIOMYELITIC DEFORMED FOOT.
Preoperative radiograph: Typical varus deformity.

1. Left foot with varus deformity prepared for triple arthrodesis.



2. Sural nerve exposed for retraction.



3. The peroneal tendons are isolated for retraction. *See next page for additional illustrations.*

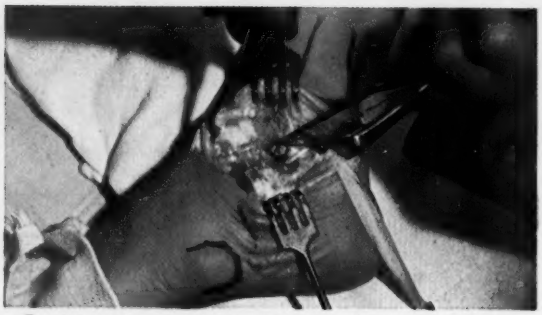
To tell it better . . .
tell it with both radiography and photography.

The case shown here is a good case in point. Radiographs helped the physician establish his diagnosis, guided the surgical repair which color photographs, in turn, recorded.

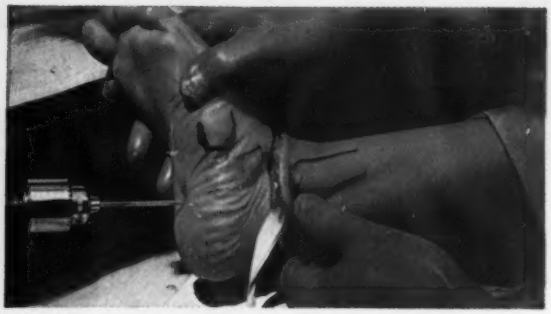
Visual material of this type is invaluable to physician and student. For here is a factual, objective record for study and research, a teaching instrument of use for years to come.

Kodak
TRADEMARK

4. Full exposure of the three tarsal joints to be fused.



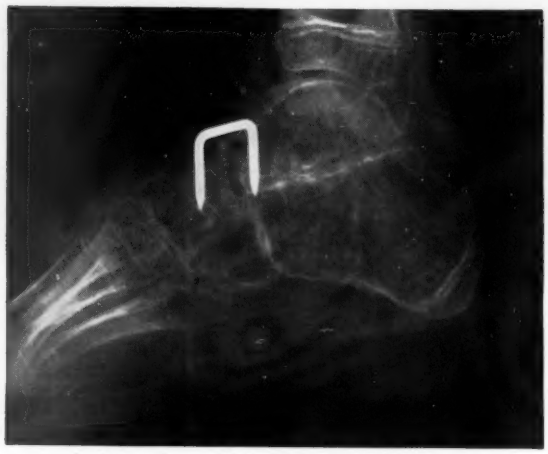
5. Correction of deformity by removal of bone wedges.



6. Fixation of the foot in the corrected position.

7. Suture of wound prior to application of plaster casing.

For Radiography: Kodak Blue Brand X-ray Film and Kodak x-ray processing chemicals meet the most exacting requirements. They are always dependable—uniform. Quality-controlled—rigidly tested—they are *made to work together.*



Postoperative radiograph: Corrected position.

For Color Photography: Kodachrome Film for miniature and motion-picture cameras;

Kodak Ektachrome Film and Kodak Ektacolor Film, Type B, for sheet-film cameras;

Kodak Ektachrome Roll Film for roll-film and miniature cameras.

Order x-ray products from your x-ray dealer, photographic products from your photographic dealer.

Kodak
TRADEMARK

EASTMAN KODAK COMPANY, *Medical Division*, Rochester 4, N. Y.

Second Edition

THE HEAD AND NECK IN ROENTGEN DIAGNOSIS

By

EUGENE P. PENDERGRASS, M.D., *Professor of Radiology and Chairman of the Department of Radiology, University of Pennsylvania*

J. PARSONS SCHAEFFER, M.D., Ph.D., *Professor of Anatomy and Director of the Daniel Baugh Institute of Anatomy, Emeritus, Jefferson Medical College*

PHILIP J. HODES, M.D., *Professor of Radiology, University of Pennsylvania*

IN TWO LARGE VOLUMES

Complete index for both volumes in each volume

In part *rewritten* and *rearranged*, at places *greatly extended*, and new sections added.

NEW TECHNICS — NEW INTERPRETATIONS
NEW DESCRIPTIONS — NEW ILLUSTRATIONS

THE MOST EXPERT KNOWLEDGE ABOUT THE ROENTGEN DIAGNOSIS OF THE **DISEASES, INJURIES,** AND **ANATOMICAL VARIATIONS** OF THE HEAD AND NECK:

- Normal and abnormal conditions
- Conformations
- Fundamental and Variational anatomy
- Developmental variations
- Physical signs and symptoms
- Functional and pathological observations of the head and neck region exclusively

2403 illustrations, many new, illuminate the text

ILLUSTRATIONS: The 2403 illustrations deserve special comment for their **newness, clarity,** and **usefulness.** They are not only superior in concept and scope but most all are new and original. Many reveal new facts not heretofore included in the literature. Many of these illustrations are concerned with basic technical procedures. All are carefully prepared and unusual anatomical illustrations which make new aspects of anatomy available. The greatest care was exercised to correlate anatomical structures with the shadows seen on roentgenograms.

THOMAS BOOKS SYMBOL OF LEADERSHIP

1880 pages (7 x 10) **2403 illustrations** **$37.50**

CHARLES C THOMAS • PUBLISHER • SPRINGFIELD • ILLINOIS

X-RAY THERAPY SHIELDS
FOREIGN BODY LOCATORS

Write for descriptive literature and prices

Serving the Profession Since 1851

Mager and Gougelman, Inc.

30 North Michigan Avenue, Chicago 2, Illinois

NEW BOOK FOR ROENTGENOLOGISTS

Joseph Levitin and Ben Colloff—ROENTGEN INTERPRETATION OF FRACTURES AND DISLOCATIONS

Because the roentgenologist is often consulted about the diagnosis, about proper alignment and about the progress and success of treatment of the patient, he will welcome this book. He is not only expected to diagnose the fracture but also to advise whether the reduction is satisfactory, whether motion should take place, and give his opinion as to the status of healing. 284 pages, 258 illustrations, $7.75.

CHARLES C THOMAS • PUBLISHER • SPRINGFIELD • ILL.

THE MOST EXPERIENCED
FILM BADGE SERVICE
ST. JOHN X-RAY LABORATORY
CALIFON, NEW JERSEY
Established 1925

NEW BOOK FOR ROENTGENOLOGISTS

Emile Holman—NEW CONCEPTS IN SURGERY OF THE VASCULAR SYSTEM

This volume focuses attention primarily upon problems associated with injuries and aneurysms of the vascular system. The author draws upon experiences in the Korean War to illustrate the great value, in avoiding gangrene and amputations following injuries to the large arteries, of prompt excision of the traumatized vessel wall and direct reanastomosis. A monograph in American Lectures in Surgery edited by Michael E. De Bakey, M.D., and R. Glen Spurling, M.D., 112 pp., 126 il., $3.50.

CHARLES C THOMAS · Publisher · Springfield · Illinois

HANLEY ECONOMY FLOOR SPACE SAVERS
NOW X-RAY CABINET WITH SLIDING DOORS

5 COMPARTMENT SIZE—DIVIDERS 14 x 17 .....$105.00
3 COMPARTMENT SIZE—DIVIDERS 14 x 17 ..... 85.00
5 COMPARTMENT—DIVIDERS 10 x 12 ..... 103.00
PHOTO ROENTGEN CABINET FOR CHEST FILMS 4 x 10
8 COMPARTMENT MEDICAL RECORD FILE 8½ x 11 .. 110.00

F.O.B. ST. LOUIS, MISSOURI.
CATALOG
HANLEY MEDICAL EQUIPMENT CO.
3614 South Grand X-Ray Division St. Louis 11, Mo.

CONSOLIDATED INDICES

Volume IV

embracing

The American Journal of Roentgenology Radium Therapy and Nuclear Medicine

Volumes 59-68 (1948-1952)

• Compiled under the direction of the Publication Committee and the Editorial Office of the American Roentgen Ray Society.

• Covers 8,000 pages of original papers, editorials, biographical and historical sketches, and abstracts of both domestic and foreign journals published in The American Journal of Roentgenology, Radium Therapy and Nuclear Medicine for the years 1948 to 1952.

• Fills a very definite need and will be welcomed by those who have occasion to consult the Journal during this five year period. Increases the usefulness of your set of journals a hundredfold.

Volume I (1903-1937)	$12.50
Volume II (1938-1942)	5.00
Volume III (1943-1947)	12.50
Volume IV (1948-1952)	13.50

(Purchasers outside U.S.A. should send cash with order. Delivery, postpaid, guaranteed.)

CHARLES C THOMAS • PUBLISHER
301-327 East Lawrence Avenue · Springfield, Illinois

NEW

Volume Four

CLINICAL ROENTGENOLOGY

The Digestive Tract
the Gall Bladder
Liver and Pancreas
the Excretory Tract

The Authors

ALFRED A. DE LORIMIER, M.D.
Radiologist
Saint Francis Memorial Hospital
San Francisco

HENRY G. MOEHRING, M.D.
Radiologist
Duluth Clinic
Duluth, Minnesota

JOHN R. HANNAN, M.D.
Radiologist
Cleveland, Ohio

ORGANIZED AND WRITTEN FOR PRACTICAL CLINICAL USE: This volume provides a presentation of the roentgen approach for study of all portions of the alimentary tract, the excretory tract and for special studies such as pertain to gynecological, obstetrical and the male genital tracts. As in previous volumes, each subject is introduced by a "brief" of **generalities, the clinical aspects** and **corroborative laboratory findings** to be expected.

X-Ray diagnostic methods are integrated with the **total clinical picture** in each condition considered.

FEATURES WORTH NOTING:

1. *All illustrations are in the same tone as the original roentgenograms; reproductions are in the* ***original X-Ray negatives.***

2. *Differential diagnosis* is emphasized in separate, easily located, concisely written sections for quick reference.

3. *Double column format* for ease of reading.

4. *Practical technical roentgenologic* aids are discussed to point the way toward maximum exploitation of X-Ray diagnostic methods in each case.

5. The clear division into *introduction, clinical, X-Ray considerations, laboratory* and *differential diagnosis* allows the reader to get pertinent points without hours of reading.

764 pages (8½ x 11) 1112 illustrations $24.50

Each Volume Contains Its Own Index

CHARLES C THOMAS · PUBLISHER
Springfield · Illinois

CLINICAL ROENTGENOLOGY. Volume I: Developmental and Systemic Conditions and Local Lesions in the Extremities.

Clinical, roentgenologic, and differential points can be located quickly and assimilated with a minimum of effort. A particular effort has been made to present the diagnostic problem in a truly scientific manner. Criteria are considered not only as they pertain to one condition but as they may be found in a number of conditions.

The importance of assembling as many diagnostic features as possible before concluding a diagnosis is emphasized. Then, WARNINGS are stressed as to the possiblities that one or even a group of these diagnostic features might indicate a condition other than that primarily considered.

516 pages (8½ x 11) 782 illustrations
1177 references $18.50

●

CLINICAL ROENTGENOLOGY. Volume II: The Head, Neck and Spinal Column.

Normal roentgenologic anatomy and physiology, general clinical considerations, technical roentgenologic aids to diagnosis are featured in this Second Volume devoted to the SKULL, PARANASAL SINUSES, TEETH AND ARTHROPATHIES OF THE SPINE.

488 pages (8½ x 11) 734 illustrations
$18.50

●

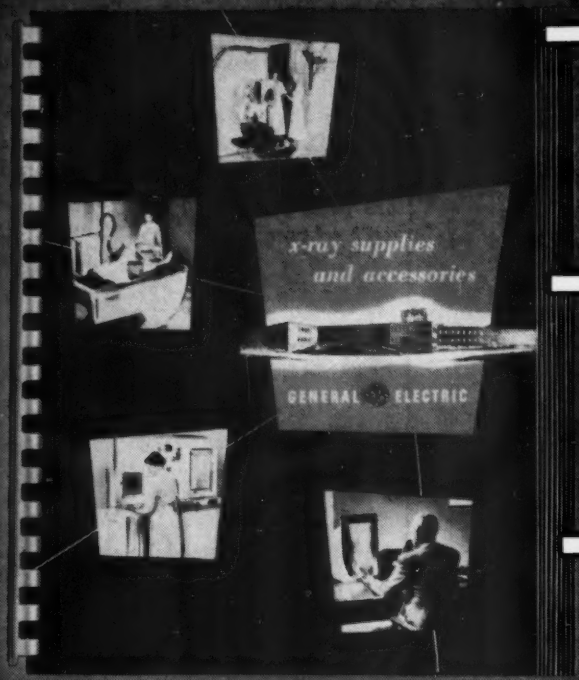
CLINICAL ROENTGENOLOGY. Volume III: The Lungs and the Cardiovascular System Emphasizing Differential Considerations.

All material in this book has been reviewed by physicians with wide experience in various specialties that deal with thoracic disease to insure that the total clinical picture is correlated as much as possible with X-Ray manifestations. Common and potential sources of error are considered in discussions of X-Ray findings and differential diagnosis.

512 pages (8½ x 11) 760 illustrations
705 references $20.50

At your fingertips--

a complete guide to x-ray supplies



New 138-page G-E catalog has 1,775 listings, 80 new products

Every supply and accessory item you need

Handy to use — fully cross-indexed, no separate price list

If you haven't received your copy, see your G-E x-ray representative, or mail this coupon.

X-Ray Department, General Electric Co.
Milwaukee 1, Wisconsin, Dept. A-126.

Gentlemen: Please send me your new "X-Ray Supplies and Accessories" catalog.

Name.....

Position.....

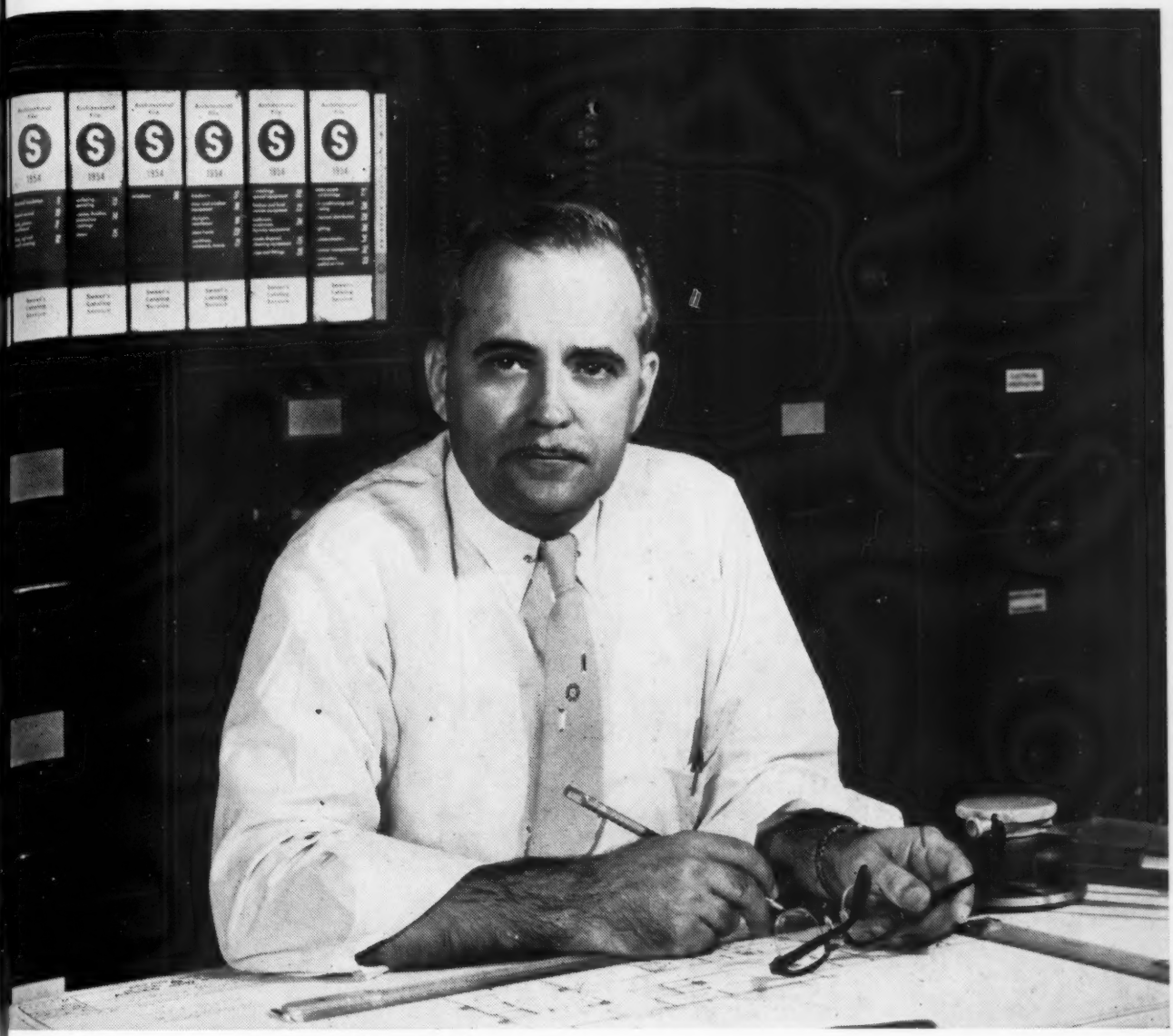
Institution.....

Address.....

City.....

Progress Is Our Most Important Product

GENERAL ELECTRIC



AVE MAKO, Manager X-ray Planning and Layout Section.

35 Years Planning X-ray Departments

This vast experience helps the radiologist and architect to tailor-make and custom-plan X-ray Departments.

We at Westinghouse firmly believe there is an X-ray layout to suit every radiologist. Let Dave Mako and his planning staff, with many years of practical experience, help *you* with *your* particular plan.

Plan to meet Dave at the Westinghouse Exhibit, Radiological Society Meeting, December 2-7th — Chicago, Illinois.

WATCH

WESTINGHOUSE!

FIRST IN ATOMIC POWER

J-08323

MEDICAL X-RAY

Westinghouse Electric Corporation

X-RAY DIVISION

2519 Wilkens Avenue, Baltimore 3, Maryland